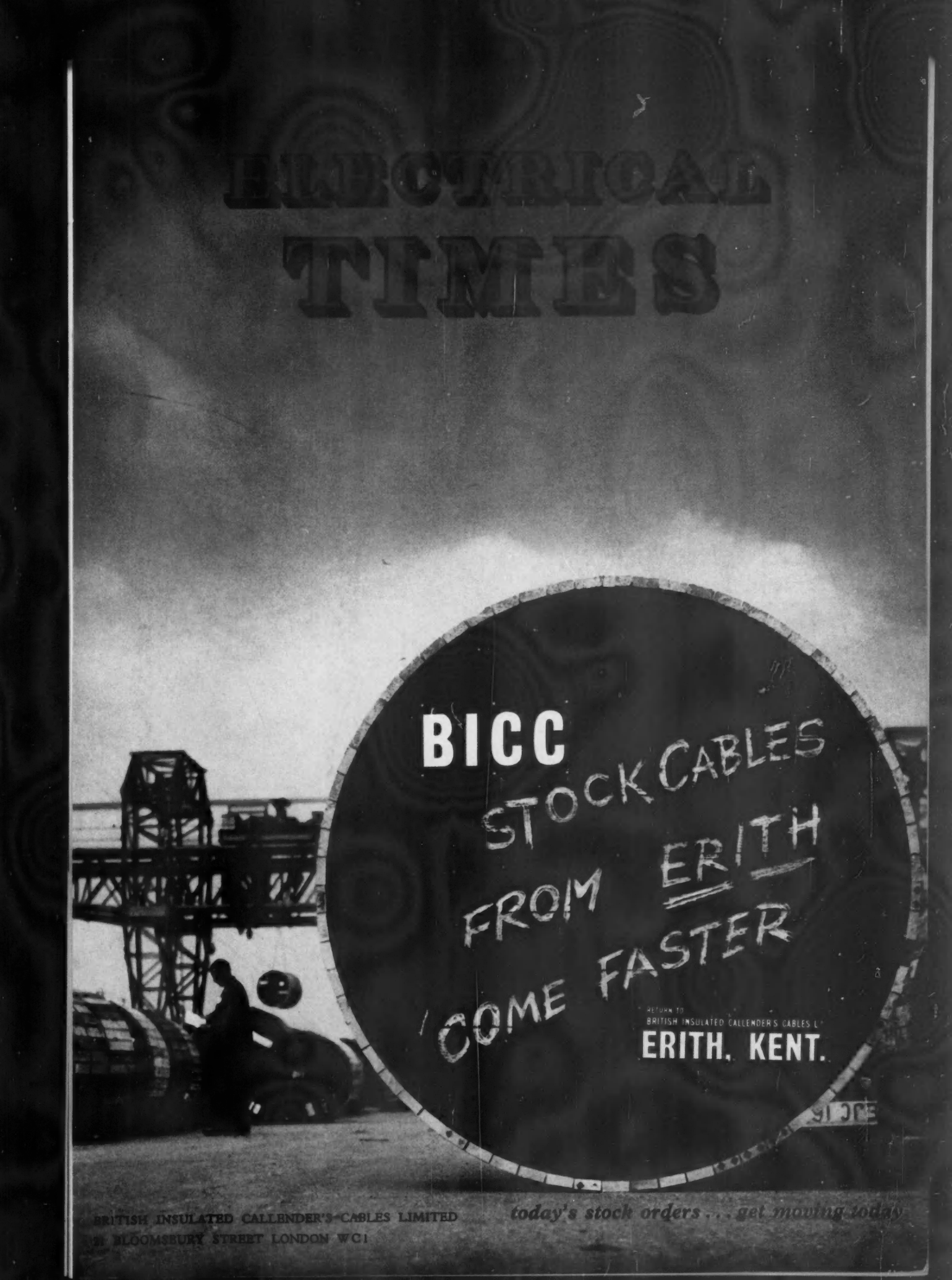
ELECTRICAL TIMES



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Photograph by courtesy of The General Electric Co. Ltd.

*Paxolin synthetic resin bonded laminates consist of various base materials—paper, cotton fabric, asbestos, glass and nylon bonded with resins such as phenolic, epoxide, melamine, silicone or polyester. They are manufactured in a wide range of grades and in the form of sheets, tubes, cylinders and moulded, punched and machined parts.

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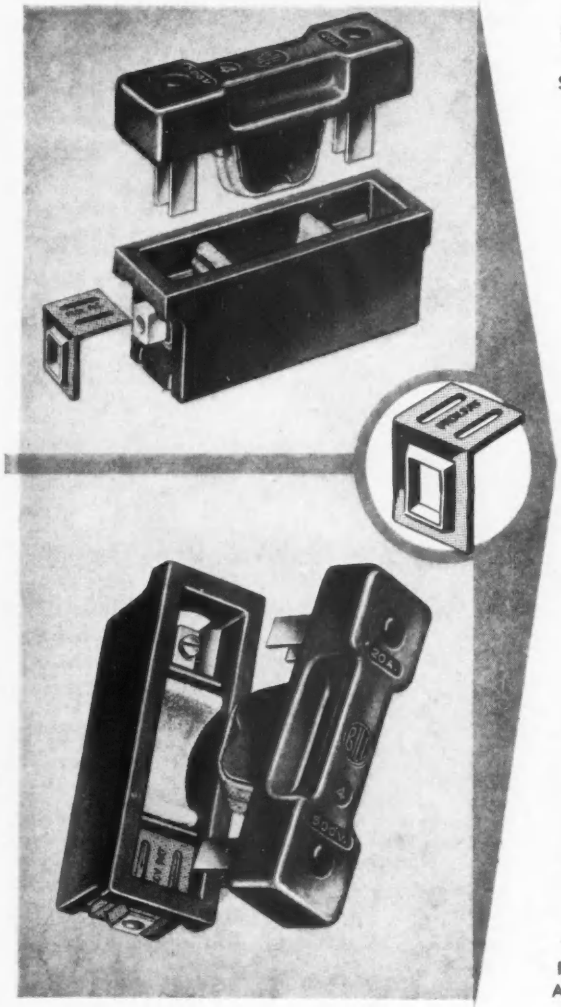

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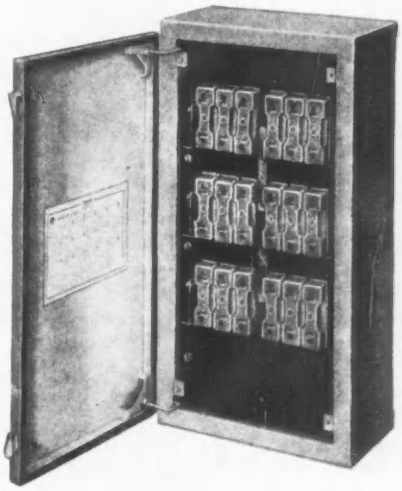

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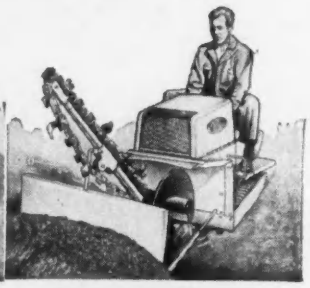

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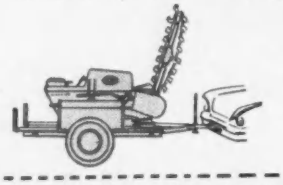

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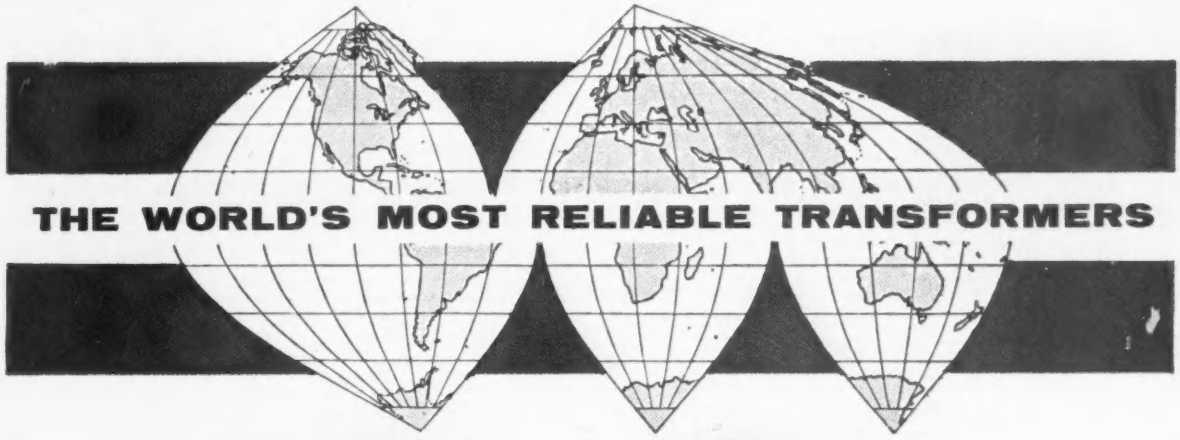

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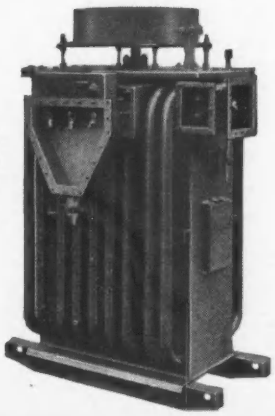
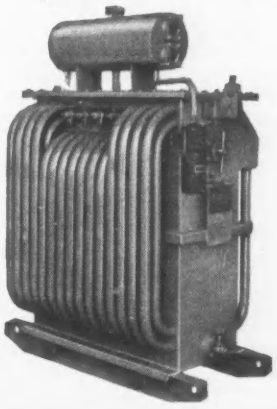
150 kVA 3 phase 3,300/440 volts with Thompson Relief Chamber as supplied to an oil refinery.





300 kVA 3 phase 11,000/433 volts transformer as supplied to East Africa.

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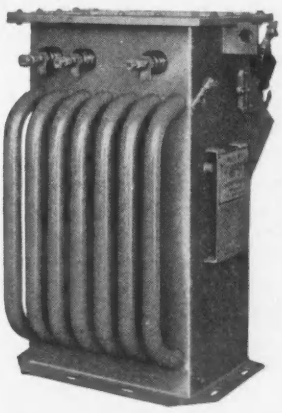
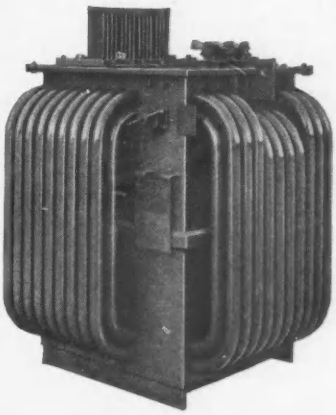
50 kVA single phase 11,000/250 volts transformer built to BEBTI/1958 specification.





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BELLING & COMPANY LIMITED

No. 38 OCTOBER 1960

Half-Yearly Report of the Governing Director

At this half-way stage in our trading year, I am glad to report that despite all the adverse factors we know of and also read about, we ourselves have been kept pretty busy. Our cookers have been selling well, in fact beyond our capacity to deliver in some cases, with the No. 47 model still highly popular and the No. 48T model now firmly established. Both these cookers are great favourites with those who install them and also with those who use them.

To these models we have now added our four-plate No. 60 and our four-plate horizontal No. 70 cookers, which are now coming into quantity production. Both these cookers will, I am sure, soon become best-sellers in their respective fields.

On the heating side of our business our Burnley Works have been very fully occupied with the manufacture of fires and convectors for sale in the heating season just commencing and we feel we can look forward to a healthy volume of orders, with rapid deliveries on our part from our stock.

Turning to figures for a moment, we are now some 22% ahead of last year's sales, but not, as yet, up to our target. Our profit margin tends to contract however with certain of our purchases and other expenses rising, but we may yet redress this tendency by the development of further internal efficiencies.

However, I am glad to be able to pay the same interim share of the profits to our employees as last year. The final distribution, naturally enough, depends on how things go in the next six months. We feel business will be good and with increased sales and increased efficiency at both of our Works, I hope it will be possible for us to maintain the final share out of profit at the same level as last year.

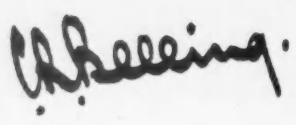
Our building programme is still forging ahead and our new big extension at Enfield is nearly completed and already partly occupied. An additional building at Enfield is already approved and construction will shortly commence. These two buildings alone will give us a further 100,000 sq. ft. of productive space. Then our third extension at Burnley is well under way, the levelling and foundations being almost complete. This will give us yet another 100,000 sq. ft. which should be available for production in early 1961.

So much for our Works side . . .

Now about Sales. Well, our latest catalogue is now in full circulation and the demand for it is very big; we shall be very pleased to forward any further quantities you would like upon hearing from you. I would like to emphasize that we are offering today a truly comprehensive range of heating and cooking appliances and your customers will assuredly find something to meet their individual requirements from the variety of designs and sizes we are producing. It is true to say that there is today a greater interest than ever before in the real benefit of adequate heating of the home. The wonderful selection of Belling Electric Fires and Convectors which we have available will, I feel sure, help to meet the growing demand for clean, fast and efficient electric heating, which avoids the upset of major installation work of a costly nature.

The Belling range of Electric Cookers also represents a remarkable variety of size to meet every purse and every purpose. All are beautifully designed, all are eminently practical, and all are well-made and finished. They are today's best value in cookers, the most important item in any kitchen.

We do look forward, therefore, to continuing to receive a good share of your fire and cooker orders and we, on our part, shall endeavour to give an all-round improvement in delivery and service.



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The boiler to be supplied by

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with steam conditions of

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AND REHEAT TO 713 lb./sq. in., 1,055°F, to steam a

375 M W GENERATOR

This Company, which is able to draw upon a considerable experience of supercritical-pressure boiler plant in other Babcock installations, is proud to be in the forefront of this important advance, with its potentiality for valuable increases in power station overall thermal efficiencies.

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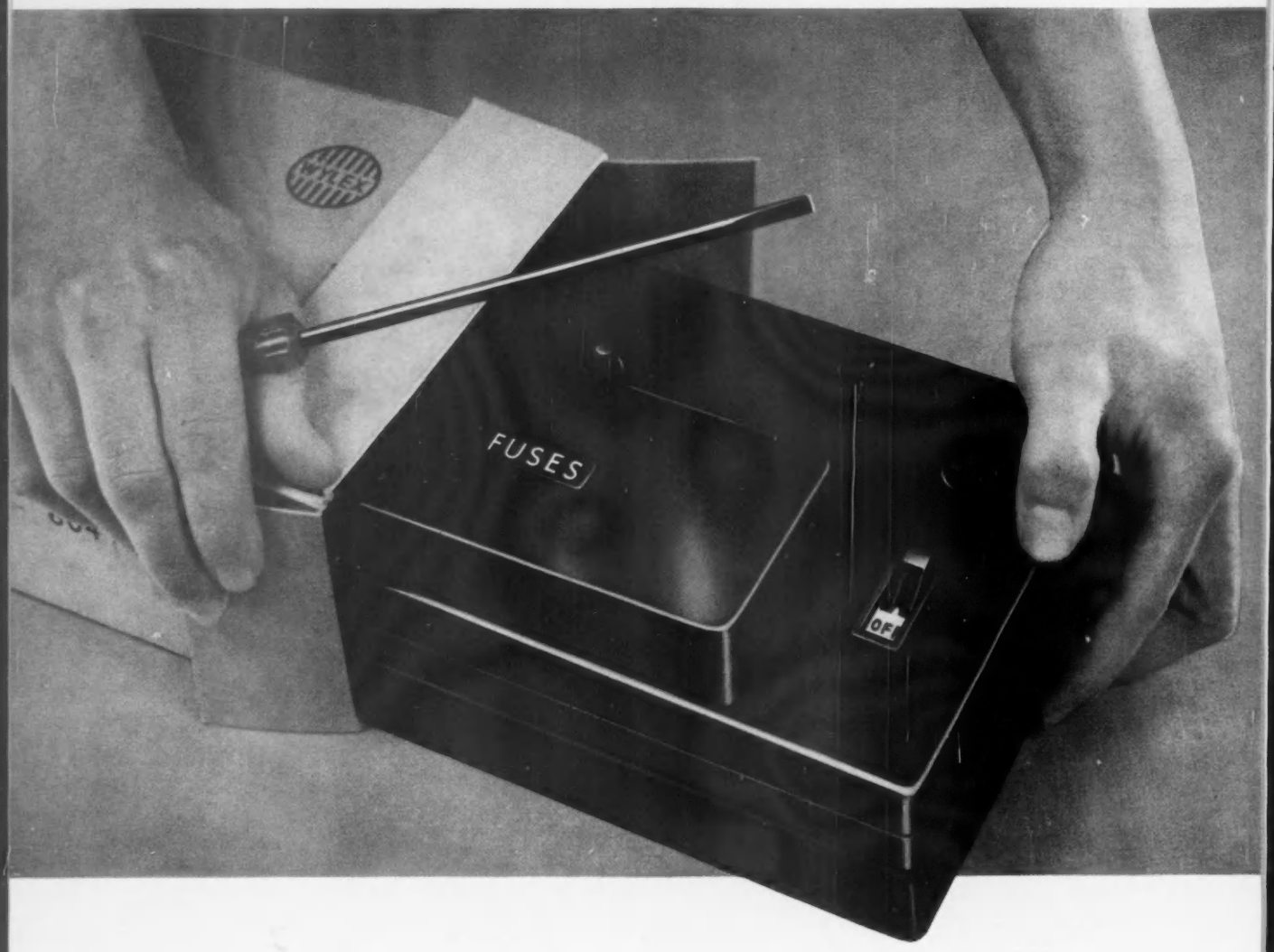
FG.51

Something you know from experience...



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Features like the easily accessible terminals, ample wiring room, domed end screws . . .
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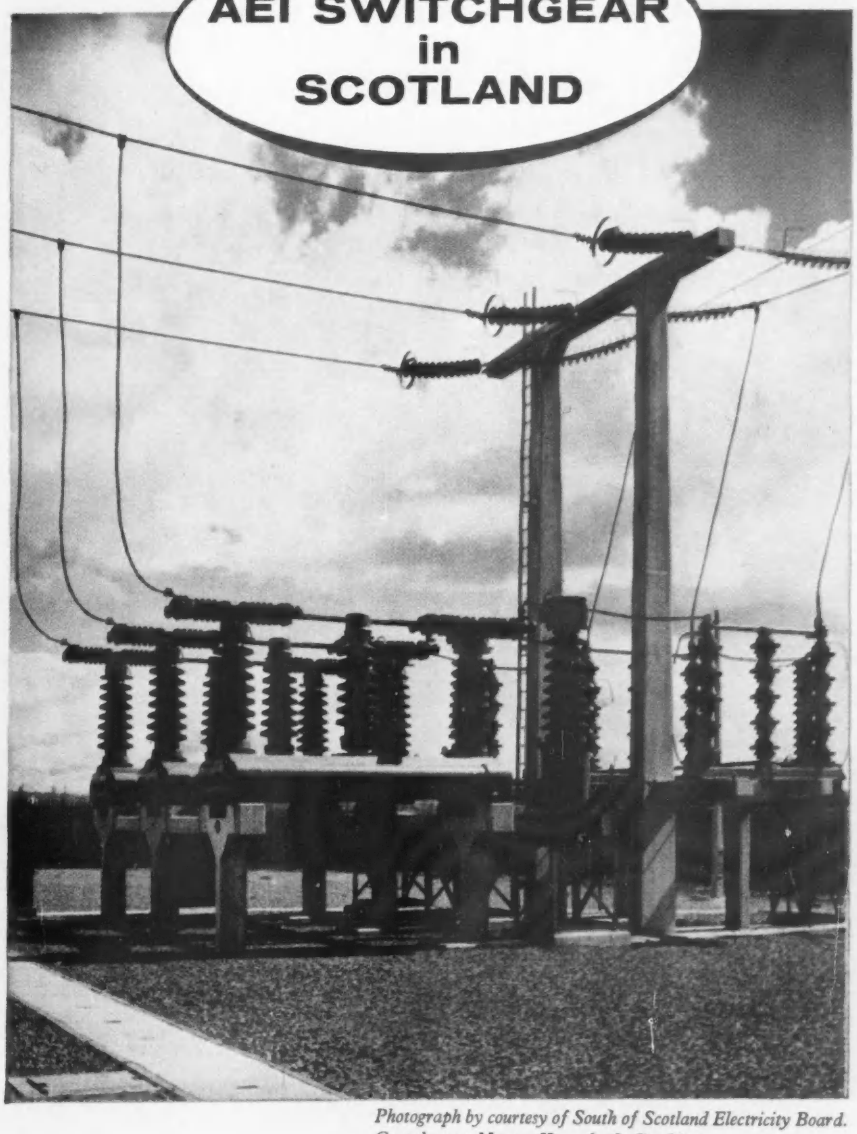
AEI SWITCHGEAR in SCOTLAND



Photograph by courtesy of South of Scotland Electricity Board. Consultants: Messrs. Kennedy & Donkin.

This twelve-switch, outdoor switching station at Neilston, Renfrewshire (South of Scotland Electricity Board) is equipped with air-blast circuit-breakers of the type GA6W4, with a rating of 132 kV—3500 MVA, manufactured by AEI. Two further circuit-breakers of the same type are to be added. These will control the 132 kV side of the two 'Supergrid' transformers which will be installed in the adiacent 275 kV Sub-station. In addition, outdoor current-transformers and extensions for the existing control and relay boards will be supplied.

The generating station at Kincardine-on-Forth is similarly equipped with AEI switchgear, to the order of the South of Scotland Electricity Board. These installations will link up with the projected 275 kV scheme in South Scotland.

For further details, write to AEI Switchgear Division, Trafford Park Manchester 17 or to your local AEI Office.

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Think of the money saved if this is done before they are delivered.

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On receipt they need only be fixed into position and connected up—just like T.R.S.

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They can also be used to advantage in the wiring of machine tools, petrol pumps etc. Remember—M.I. cable wiring units with an oversheathing of P.V.C. offer complete protection against corrosion.

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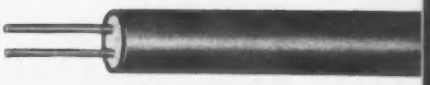
Any size of M.I. cable can be provided in wiring unit form and, because of factory mass production facilities, they can be produced at a very low cost providing that sufficient quantities of identical units are ordered.



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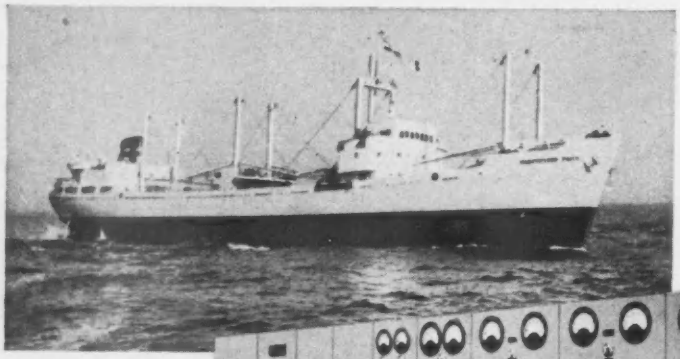
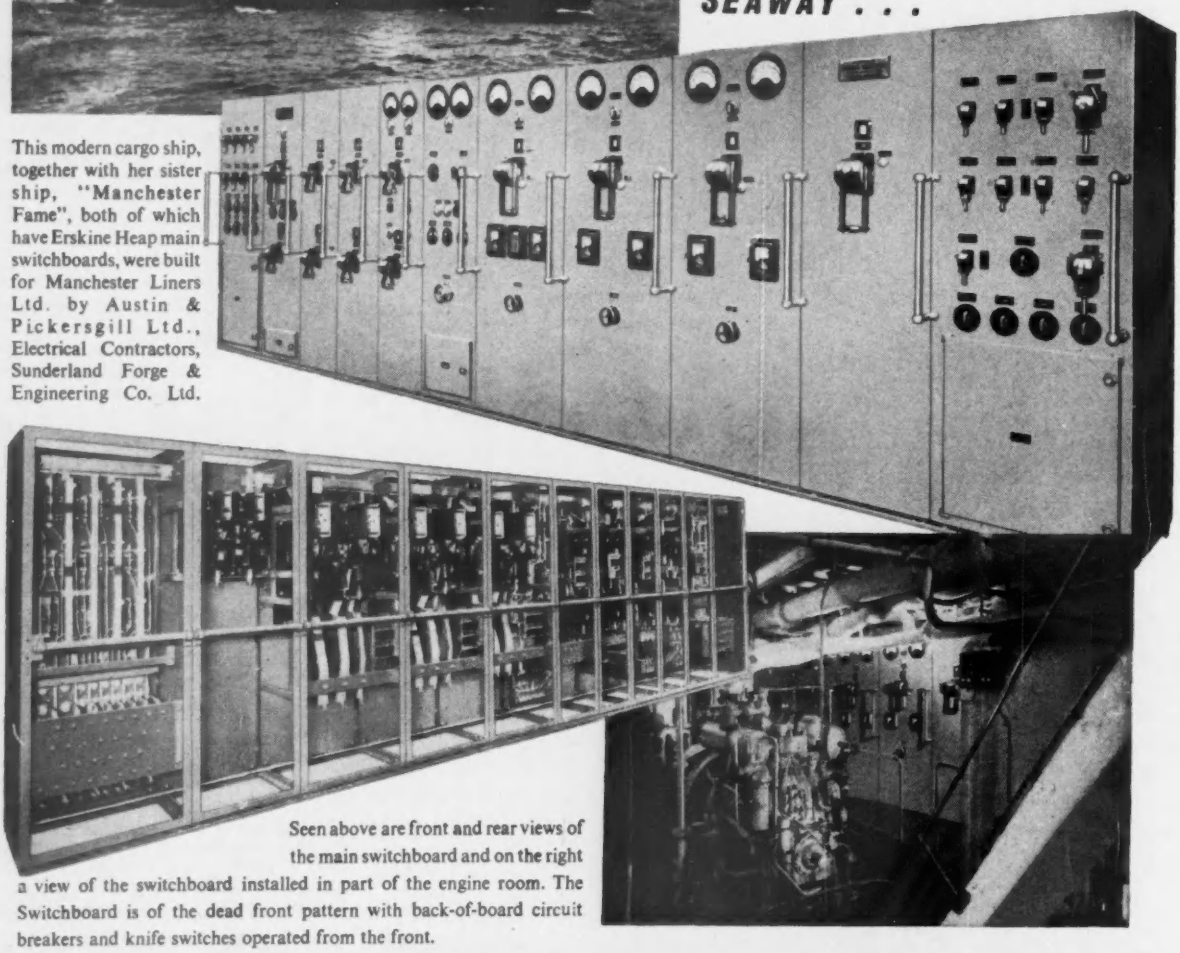
INSTALLED IN THE 'MANCHESTER FAITH'

THE FIRST BRITISH SHIP TO ENTER THE ST. LAWRENCE SEAWAY . . .



This modern cargo ship, together with her sister ship, "Manchester Fame", both of which have Erskine Heap main switchboards, were built for Manchester Liners Ltd. by Austin & Pickersgill Ltd., Electrical Contractors, Sunderland Forge & Engineering Co. Ltd.



Seen above are front and rear views of the main switchboard and on the right a view of the switchboard installed in part of the engine room. The Switchboard is of the dead front pattern with back-of-board circuit breakers and knife switches operated from the front.

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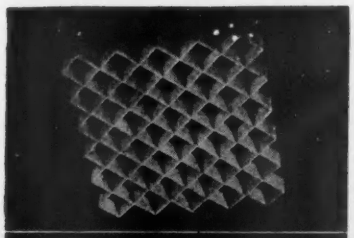

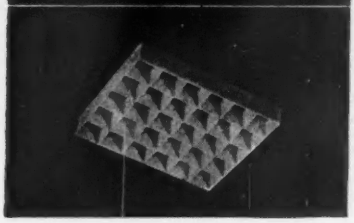

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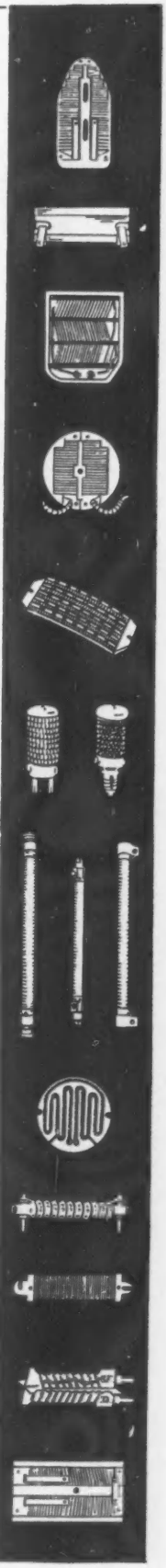
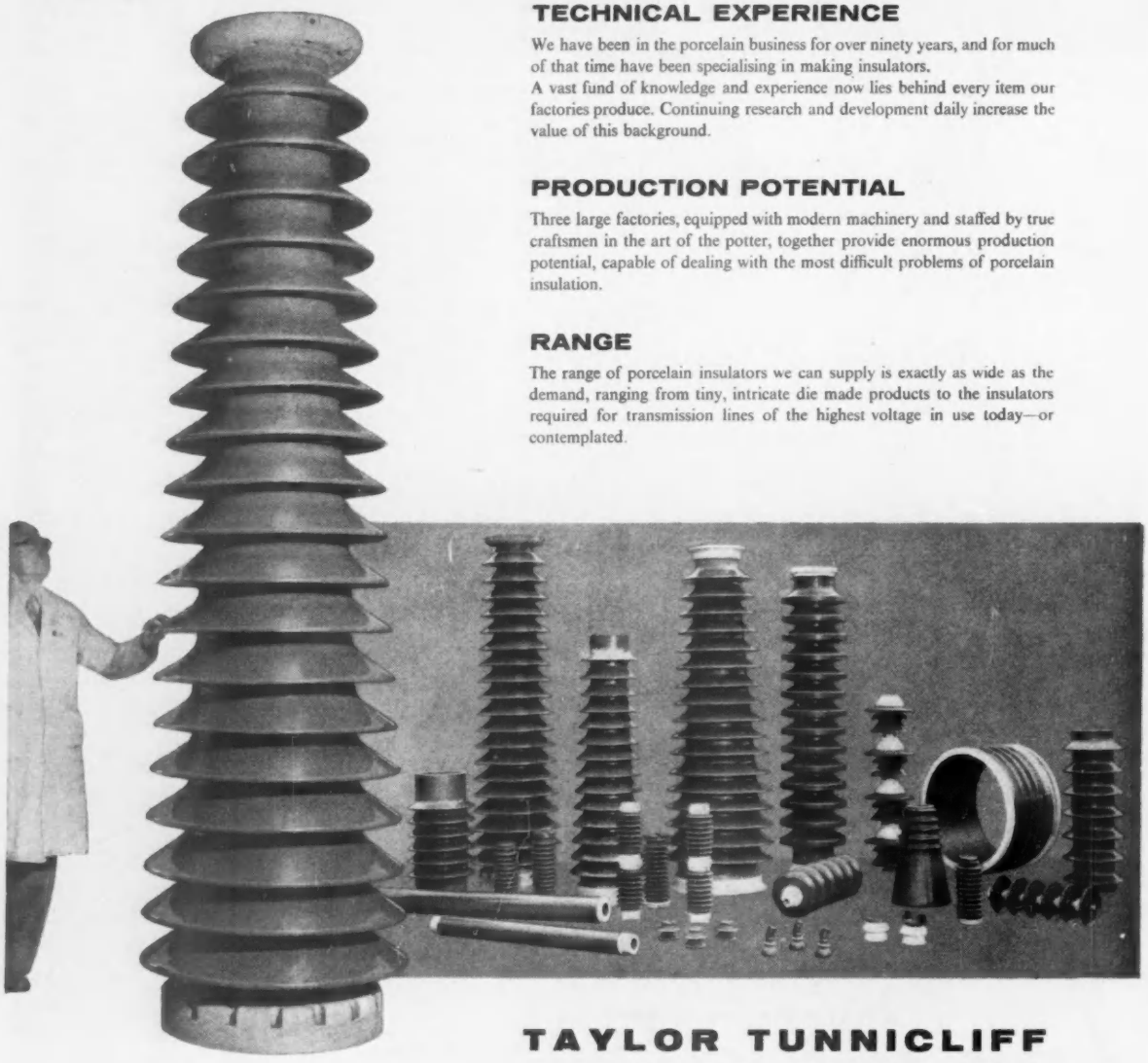


VAST



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A vast fund of knowledge and experience now lies behind every item our factories produce. Continuing research and development daily increase the value of this background.

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The range of porcelain insulators we can supply is exactly as wide as the demand, ranging from tiny, intricate die made products to the insulators required for transmission lines of the highest voltage in use today—or contemplated.

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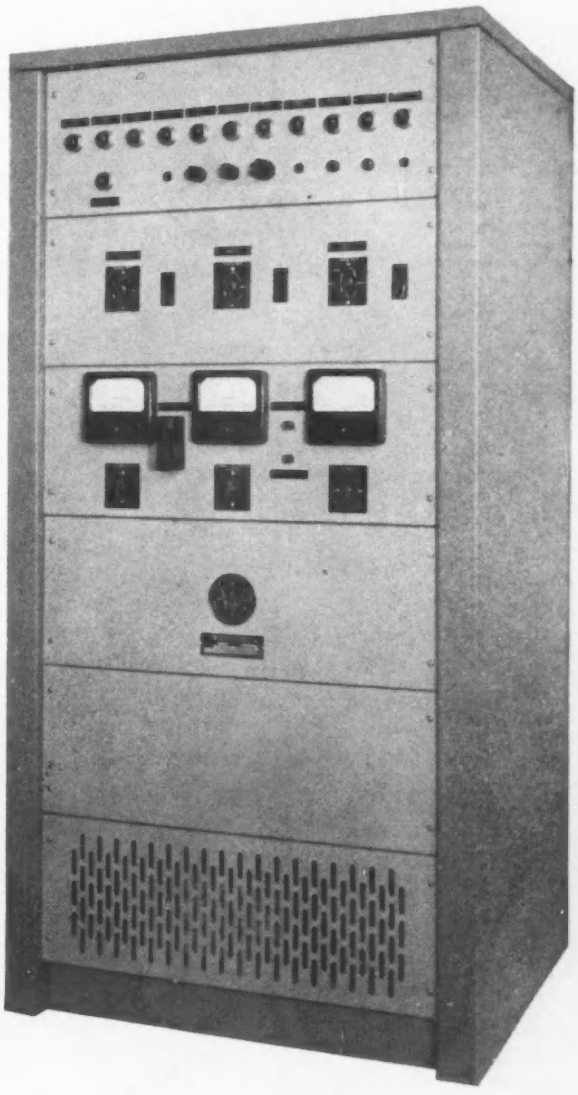
WESTINGHOUSE

RECTIFIERS

for EMIDEC DIGITAL COMPUTERS



Power supplies for EMIDEC 1100 digital computers are provided by Westinghouse rectifiers type 1451. These equipments comprise thirteen separate a.c. and d.c. power circuits for operating various sections of the computer. There are eight d.c. constant potential circuits included, each employing the WESTAT principle. Outputs of these circuits vary from 75 watts to 1200 watts and they are designed to have a fast dynamic response to pulse loads and to transient changes in mains voltage, together with close limits of overall stability.

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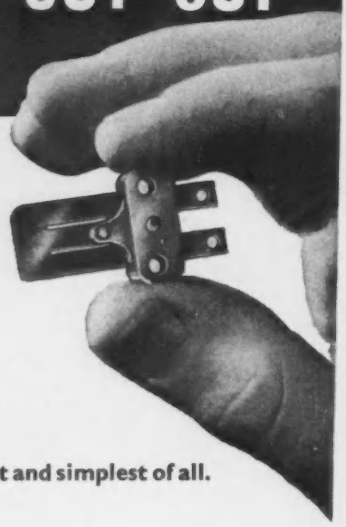

World Patents including Patent Numbers 600055, 622781, 624905, 657434, 713443, 749716, 774911, 782668, and others. Also other patents Pending.

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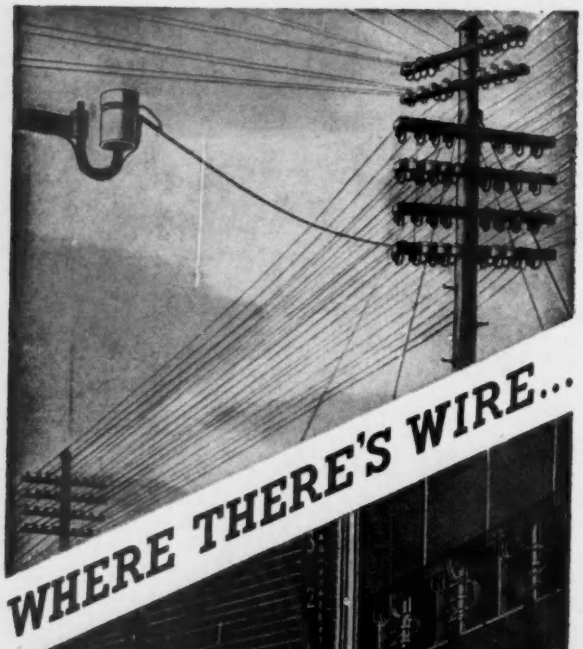
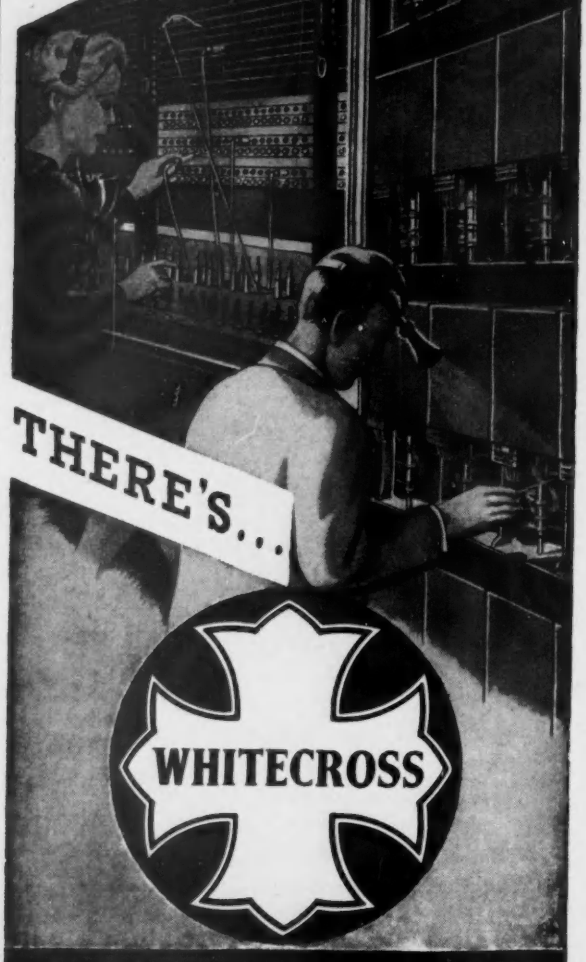


WHERE THERE'S WIRE...



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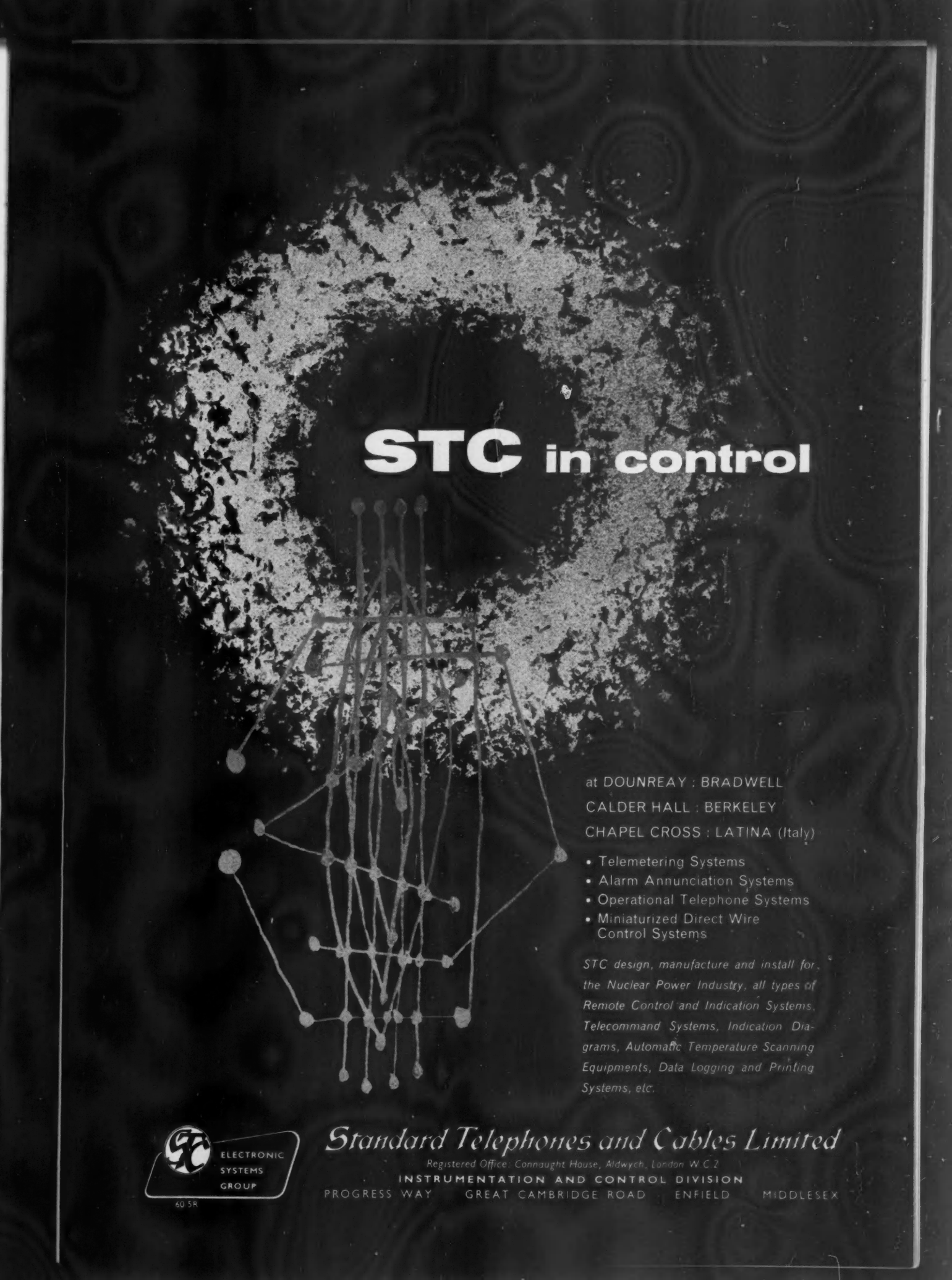
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BRUSH

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LOUGHBOROUGH ENGLAND

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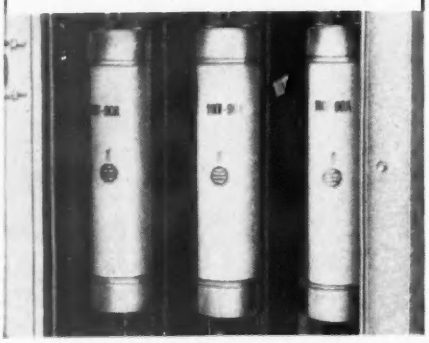
Type HF 11 Switch-Fuse unit, with chamber door open, showing 90 ampere 11 kV fuse-links.



S7

NEWS SHEET

Electrical Approvals Board starts operation. 30 November final date of application for approval of first group of appliances; fires, kettles, cleaners and blankets. Notification of results on 28 February next. Other appliance groups will follow at reasonable intervals. (583, 594)

26 months between statutory inspections of large water-tube boilers recommended in report of Honeyman Committee to MoL for Factories Act action. Same interval for nuclear station heat exchangers; small boiler inspections to remain every 14 months. (584, 590)

£3m. factory equipped for largest forseeable transformers now operating at EE Co's Stafford works. Equipment includes 4·8 MW, 346 kW-sec impulse generator. Transformer trends include subdivision with site erection to ease transport difficulties. US troubles with transformers traced to oil conservation technique. (584, 591)

Instrument detects o.h. line arcing fault, ice build up and conductor swinging, with location accuracy to 1%; range from 1 to 100 miles. Camera recording of fault, in interval between first relay operation and c.b. opening, i.e. about 150 milliseconds. (614)

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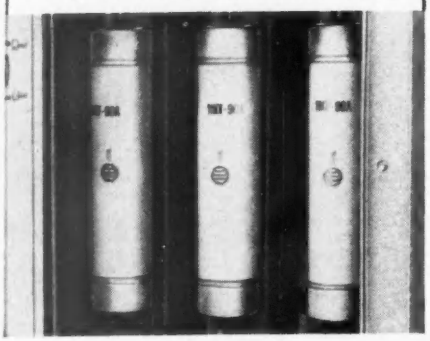

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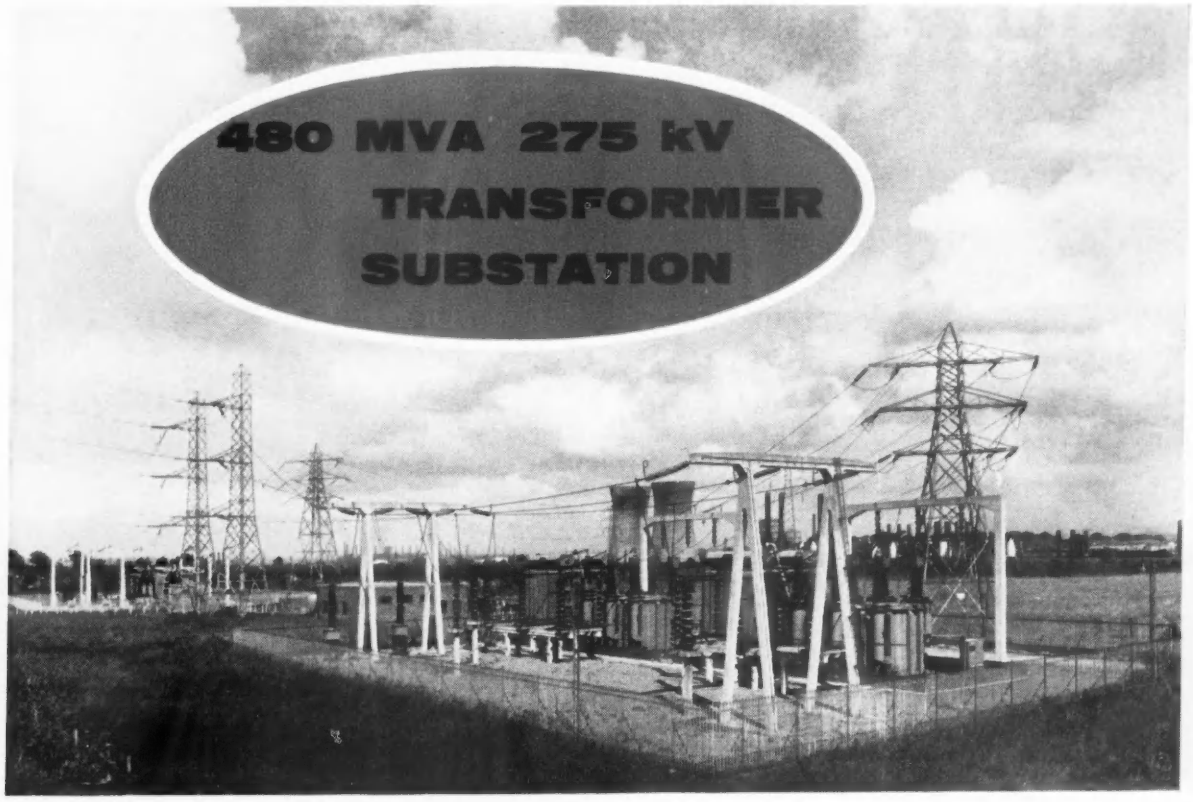

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Four 240 MVA 275/132 kV auto-transformers for the Windyhill and Neilston transmission substations of the South of Scotland Electricity Board.

Two 225 MVA 16/285 kV generator transformers, the largest double-wound transformers so far ordered for Scotland, for the Kincardine-on-Forth power station of the South of Scotland Electricity Board.

Four 30 MVA 220/66 kV transformers and seven 15 MVA single-phase units to form two 45 MVA 220/22 kV three-phase banks (one spare unit) for the State Electricity Commission of Victoria.

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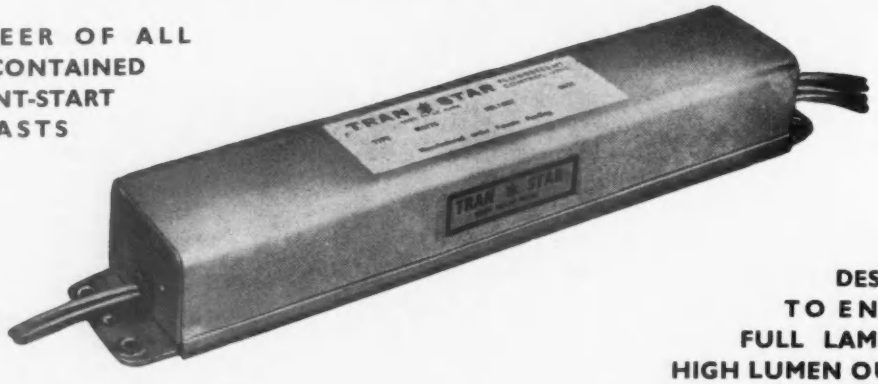

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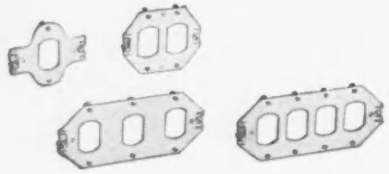

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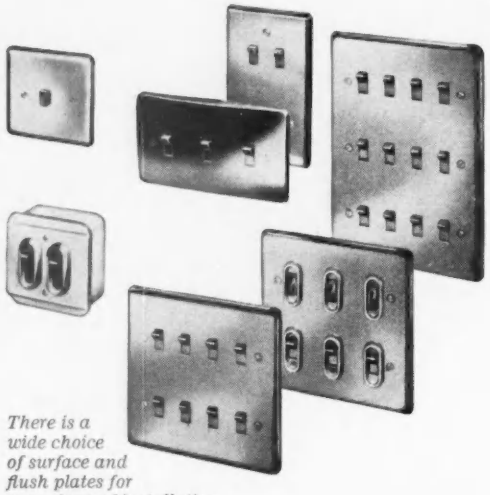

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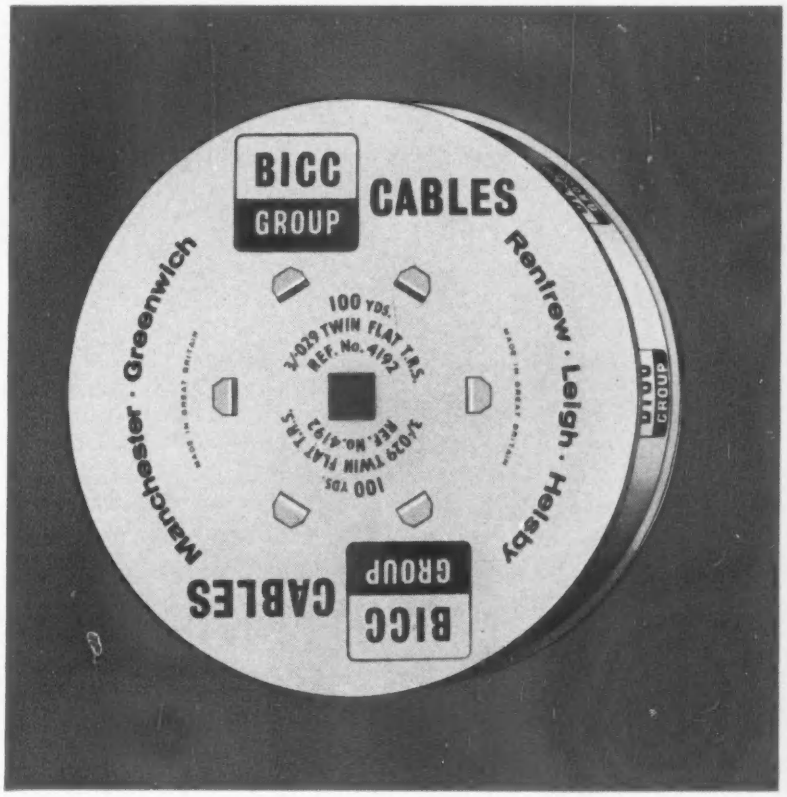

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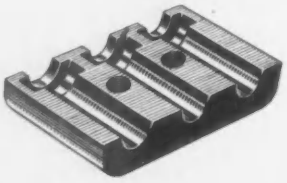
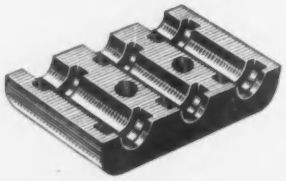
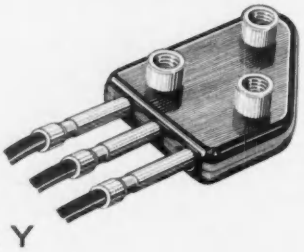

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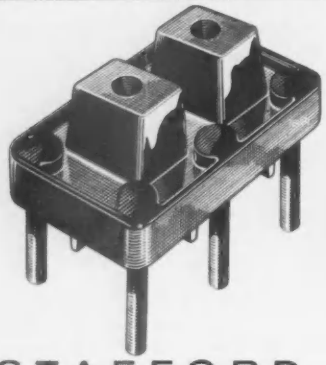
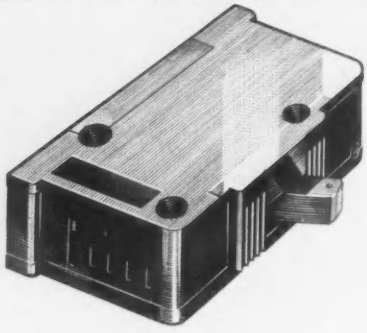

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The Illustration shows Automatic Star-Delta Starter with built-on isolator and flush mounting push button station with selector switch.

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BRITISH KLOCKNER SWITCHGEAR LIMITED

Head Office and Works: **CHERTSEY, SURREY.** Tel: Chertsey 3467. Grams: Switchgear Chertsey.

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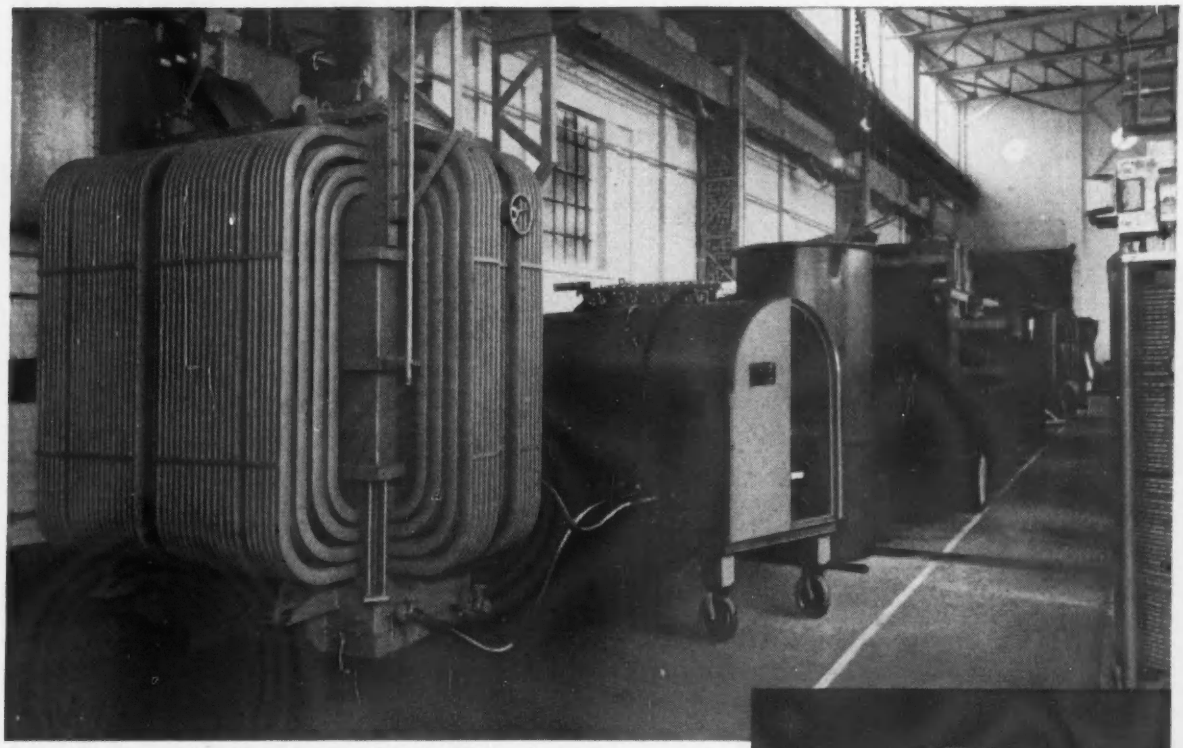

Photograph by courtesy of Bryce Electric Construction Co. Ltd., Hackbridge, Surrey.

A GOOD START IN LIFE

for insulating oil

STREAM-LINE FILTERS ENSURE SECURITY IN THE OPERATION OF CIRCUIT BREAKERS & TRANSFORMERS

New transformers and circuit-breakers need careful cleaning and drying, and must be filled with clean, dry oil. That is why so many manufacturers have installed Stream-Line filters in their works for filling transformers before they are tested and despatched.

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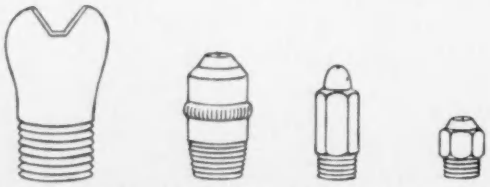

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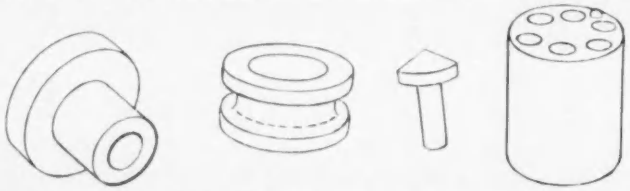
BRAY ELECTRIC HEATING ELEMENTS

BRAY



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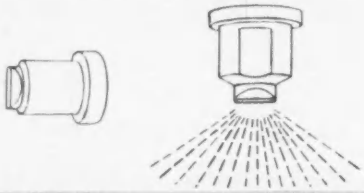

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— for defrosting refrigeration equipment

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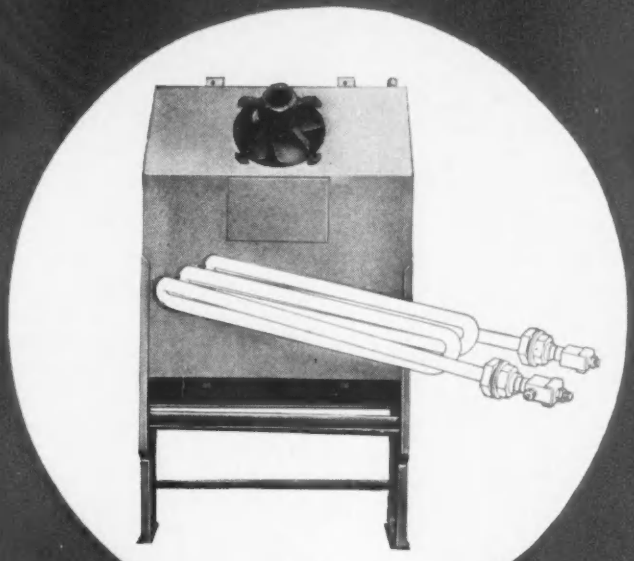

Use BRAY Tubalox elements in their Battery Type Coolers

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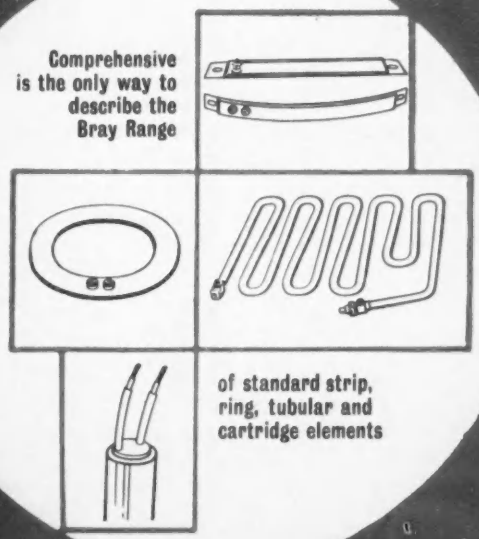
Comprehensive is the only way to describe the Bray Range



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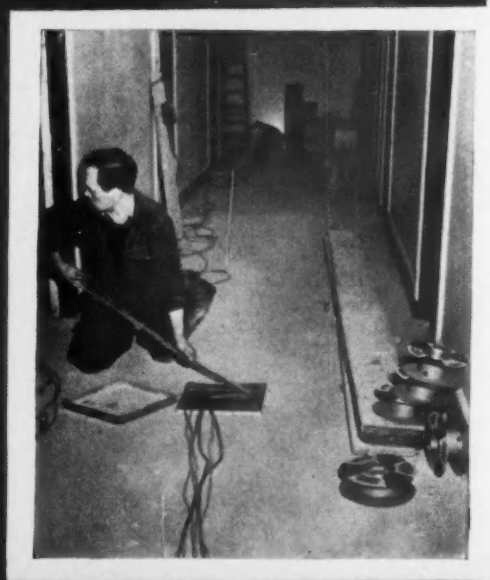
Over 77 miles of AEI cables installed in phase 1 of new Barclays Bank Head Office

In step with Britain's great expansion and expectations, Barclays resplendent, completely new Head Office is changing the face of Lombard Street. And AEI cables are on the job. Some 60 miles of AEI V.R. cables for power and lighting. Plus 17 miles of telecommunications cables for Barclays new internal telephone system. And this is Phase I alone.
YOU CAN RELY ON AEI.



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CONSULTING ENGINEERS:
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ELECTRICAL CONTRACTORS:
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CABLE DIVISION
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The Hoover Polisher
Steam-or-Dry Iron
Not for me...Santa...but for Mummy
To Santa Claus
This Christmas give every Mummy a HOOVER

GREAT HOOVER DRIVE THIS CHRISTMAS!

This Christmas, Hoover will again support you fully with a heavy and concentrated advertising campaign designed to bring the maximum number of customers into your shop.

★ **SPECIAL TV CAMPAIGN — on all stations**

★ **NATIONAL PRESS — dominating all-products ads.**

★ **PROVINCIAL PRESS — extra heavy Nation-wide bookings**

★ **FULL-COLOUR PAGES IN THE WOMEN'S MAGAZINES**

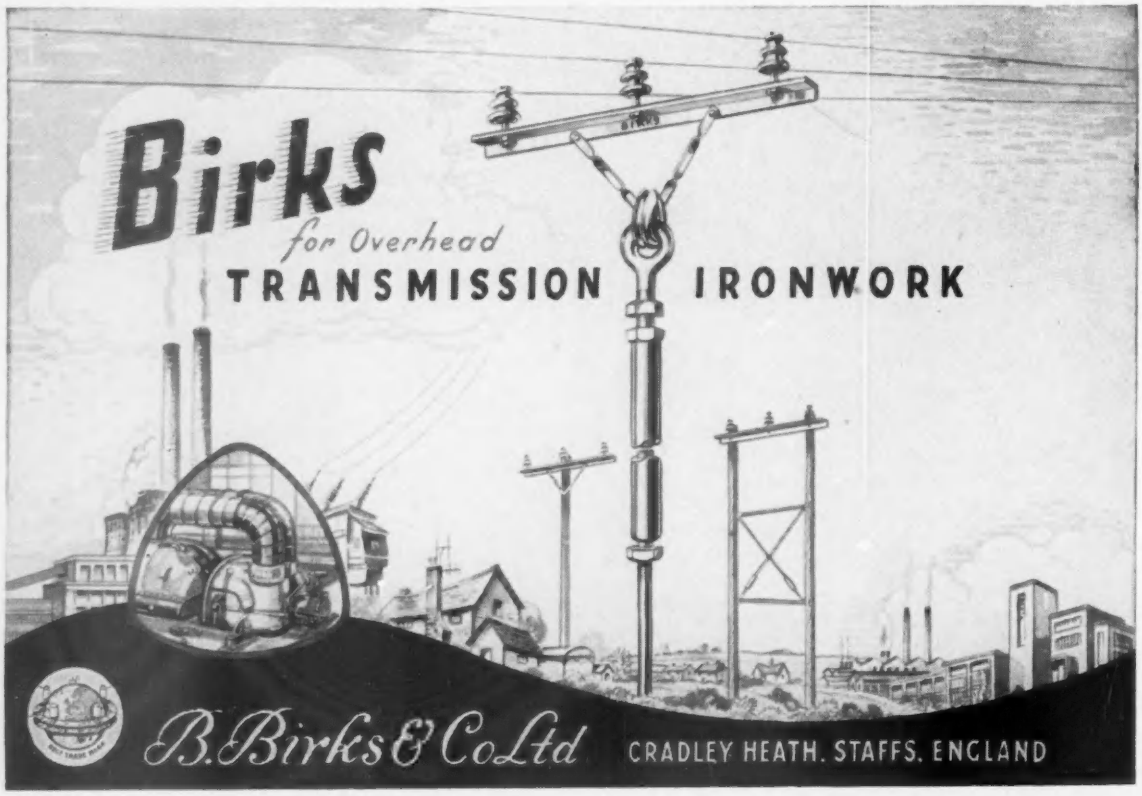
★ **FORCEFUL DISPLAY MATERIAL**

This all-out advertising effort will stimulate a tremendous demand for Hoover products! Be ready — stock up NOW! Identify *your* shop with this tremendous advertising support by installing a Hoover Christmas Display. And remember, the highly trained Hoover sales force will be pre-selling for you.

NOW IS THE TIME TO ORDER!

Profit with HOOVER this Christmas

Here is the advertisement that will be appearing in big spaces in the National press. And this theme will be echoed throughout all Hoover Christmas advertising: from TV to point-of-sale material, So tie in with eye-catching display — and sell!



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Reg. Trade Mark

Variac
Reg. Trade Mark

the original continuously-adjustable autotransformer

Series '50-ON'

Oil immersed, naturally cooled

Introduced for controlling the larger loads and providing complete winding protection where the location so demands. Offered as motor driven or with right-angle drive for standing at rear of panel.

Model	Input	Output	Rated Current
'50-B.ON'	240v	0/270v	35 amperes
'50-B/G2.ON.PO'	240v	0/270v	70 ,,
'50-B/G3.ON.PO'	240v	0/270v	105 ,,

Available for three-phase working, 35 amperes line current, maximum line voltage 465v.

Page 8 of our Catalogue VAR-5 gives details.

Model '50-B/G2.ON'

THE ZENITH ELECTRIC COMPANY LTD.

ZENITH WORKS VILLIERS ROAD WILLESDEN GREEN LONDON N.W.2

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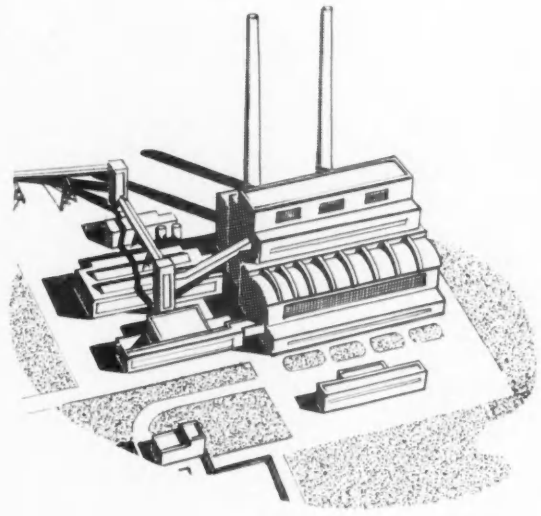
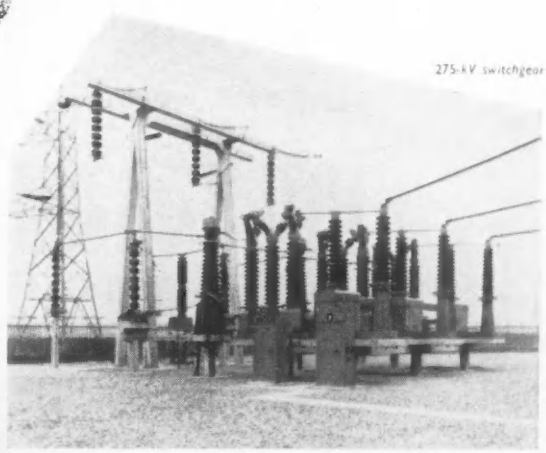
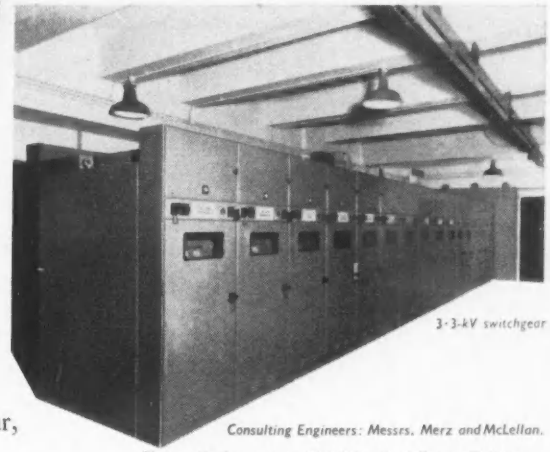


Blyth A
GENERATING STATION



275-kV switchgear

Main control-room



3·3-kV switchgear

Reyrolle supplied the 275-kV air-blast switchgear, 66-kV small-oil-volume switchgear, 3·3-kV air-break auxilliaries switchgear, and 415-volt distribution gear together with associated control-equipment.

Consulting Engineers: Messrs. Merz and McLellan.

Photographs by courtesy of C.E.G.B., North Eastern Division.

Reyrolle

A. REYROLLE & COMPANY LIMITED - HEBBURN - COUNTY DURHAM - ENGLAND

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POLYESTER

High-Heat Resisting

CLASS F + VARNISHES

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To obtain optimum results with Polyester enamelled wire wound components, a Polyester impregnating varnish should be used. In addition to their excellent thermal endurance, electric strength and moisture resistance Sterling Polyester varnishes possess a high degree of chemical resistance. They have also excellent resistance to cutting oils, special lubricating oils etc., and can thus be used as a protective coat over windings already impregnated in standard Thermobonds. Their tank stability is excellent and they can be processed without difficulty by all the conventional methods of impregnation.

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STERLING V 837	Flexible
STERLING COVAR II	Semi-Flexible
STERLING V 864	High Bonding

MADE BY CHEMISTS

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INSULATING VARNISHES

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Undoubtedly, the answer to all air and hydrogen cooling problems is PREMIER. PREMIER closed circuit coolers, among the most highly efficient and economical in the world, are installed in such important power stations as Meaford, Poole, Uskmouth, Hams Hall "C," Darlington, Bold "B," Stockport and Johannesburg; and hydrogen coolers and heat exchangers are in hand for Hunterston Atomic Power Station. PREMIER design and erect the plants, guarantee the performance and give a 100 per cent after-sales service. Undoubtedly, PREMIER Coolers are acclaimed by engineers everywhere.

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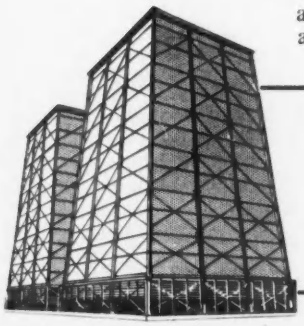

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COOLING TOWERS

WE *do the designing ourselves*
WE *manufacture our own plants*
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WE *guarantee the performance*

The PREMIER COOLER AND ENGINEERING CO. LTD., Shalford, Nr. Guildford, Surrey

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The Contemporary **1000** range

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Smooth—Streamlined—Designed! In black, white and dove grey. Stout brass barrels for greater strength, in new heat-resisting materials to conform to the recent B.S.52 supplement No. 1.

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NOW MADE IN NEW HEAT-RESISTING MATERIALS

Write Now for Details

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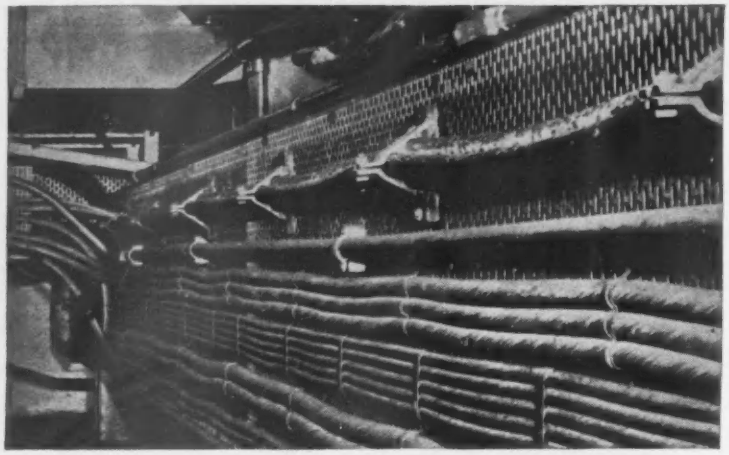
PERFORATED CABLE PLATES . . . in STEEL OR ALUMINIUM ALLOY



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Greenings Cable Plates are reasonable in cost. Please write for details.

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NG 75

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THE "54" DRAWER UNIT

ALL STEEL Stove Enamelled DARK GREEN

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OVERALL SIZE
42" HIGH
36" WIDE
12" DEEP

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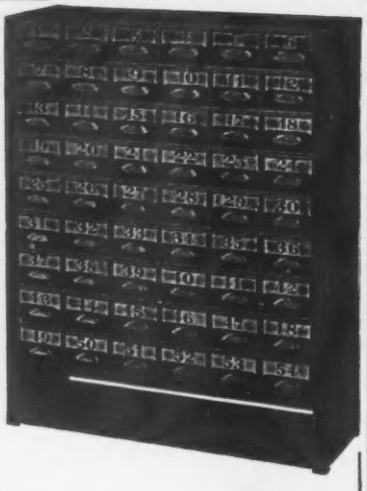
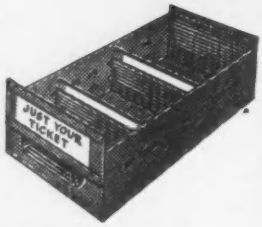


Contains 54 of these drawers, each 5" wide, 3" high, 11¼" long, 54 dividers and 54 drawer cards with each unit.
Extra dividers 6d. each.



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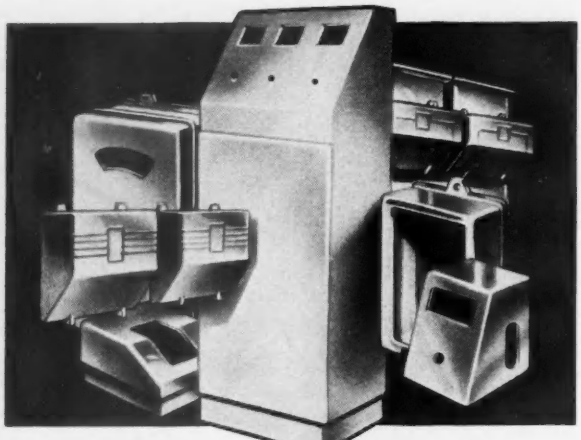


It's better, cheaper, stronger in FIBREGLASS - REINFORCED PLASTIC

Enormous strength, high insulation properties, resistance to corrosion and adaptability for producing complex shapes all combine to make Fibreglass-Reinforced Plastic ideal for switchboxes, control gear housing, switchcovers, etc. Deans specialise in the production of these, by the matched-metal die process, which ensures good surface finish and close working tolerances.
Deans technicians will be glad to advise on any technical matters concerning fibreglass applications—or to receive enquiries for repetition work.

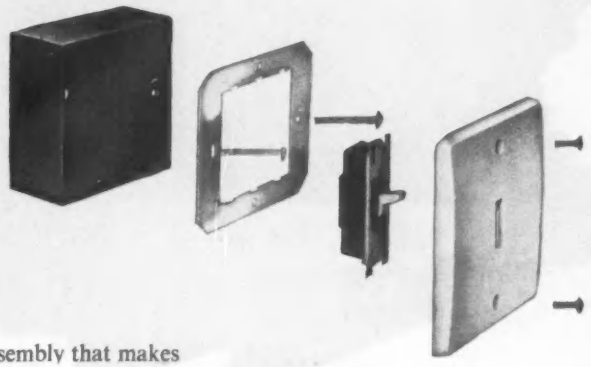
Deans

DEANS & SON (YORKSHIRE) LTD.
Beverley, Yorkshire, England
A member of the Manganese Bronze Group

BCA

'MUTAC CLIPPER'

easy-to-assemble switches cut installation costs, save time, simplify additions & alterations



Good looks to please the eye. Simplified assembly that makes good sense because it cuts installation costs—after wiring they can be put together in under a minute. These are the things you will like about the new G.E.C. Clipper Switches.

These new assemblies cover the wide range of 5 amp. S.P. 1 way, 2 way, 2 way and off, and intermediate switches, bell push, neon indicator and blanking units for commercial and domestic installations.

Your stock problems are simplified too, because only two sizes of boxes are required for the 1 to 6 gang assemblies.

A final word about those good looks—G.E.C. Clipper Switches have been accepted by the Council of Industrial Design for Design Index.

Architects, consulting engineers and electrical contractors will welcome the new Mutac Clipper range.

G.E.C.

INSTALLATION EQUIPMENT GROUP

SWITCH AND FUSE GEAR · H.R.C. FUSES · OVERHEAD BUSBARS RISING MAINS · CONDUIT · CABLE · CABLE TRUNKING · UNDER-FLOOR CABLE DUCTS · ELECTRIC WIRING ACCESSORIES · BELLS

THE GENERAL ELECTRIC COMPANY LIMITED, MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

FORD

£10 million 48 acre paint trim and assembly plant— SQUARE D gear controls vital 10 miles of flow line

Square D plays a key part in this new plant—the most advanced of its type to-day. Its selective conveyor system was designed and installed by Geo. W. King Ltd. in co-operation with Ford engineers.

One of the two control rooms which tracks and controls the movements of car bodies on the automatic transfer system through the paint shop. All breaks and changes in flow are registered and conveyor speeds regulated from this square D panel.

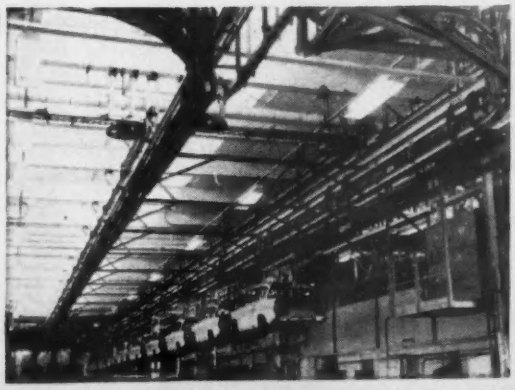
Square D was specified for the plant's complex range of automatic flow line operations. Two central control rooms, together with several local consoles designed and built by Square D, supervise the entire handling system. Hundreds of Square D 2-unit push button stations and limit switches are heavily worked in this up-to-the-minute example of automation in the motor industry.

LEADERS IN CONTROL GEAR FOR OVER 50 YEARS

SQUARE D LIMITED

. . . . wherever electricity is controlled

Local consoles sited throughout the plant supplement the two central control rooms. Here the transfer between primer and final enamel sections is supervised.



The system of indexers regulates the flow of bodies over the conveyor bridge and into twin storage lines before the phosphating process. Each line of 11 bodies is fed alternately by automatic selection.

A *Complete* LINE OF SQUARE D ELECTRICAL CONTROL EQUIPMENT

A. C. RELAYS
COMBINATION STARTERS
CONTACTORS
CONTROL CENTRES
D.C. RELAYS
ENGINEERED CONTROL SYSTEMS
FOOT SWITCHES
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FIELD ENGINEERING SERVICE
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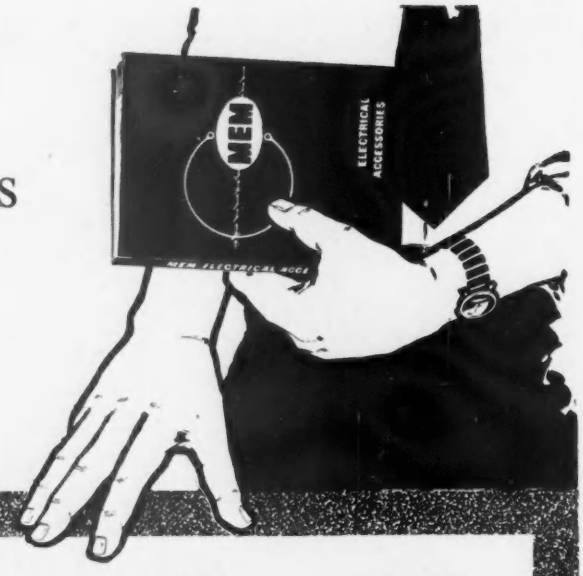
CHEYNEY MANOR SWINDON WILTSHIRE

Square D products are stocked by leading electrical wholesalers throughout Great Britain

To have the best *Specify* Square D

Electrical accessories from the MEM range



- A matched range of Socket Outlets to comply with B.S. 546 and B.S. 1363
- Flush patterns switched or unswitched can be accommodated in B.S. 1299 or B.S. 1363 type boxes, $2\frac{3}{8}$" plate fixing centres
- Flush or Surface
- Switched or Unswitched
- Domestic or Industrial
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MEM SOCKET OUTLETS

The full range is detailed in the new 88 page catalogue.
Write for your copy today, List No. 435. T

MIDLAND ELECTRIC MANUFACTURING CO. LTD. (ACCESSORIES DIVISION)
REDDINGS LANE, TYSELEY, BIRMINGHAM 11.

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invest

in quality

use BP

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INDUSTRIAL LUBRICANTS

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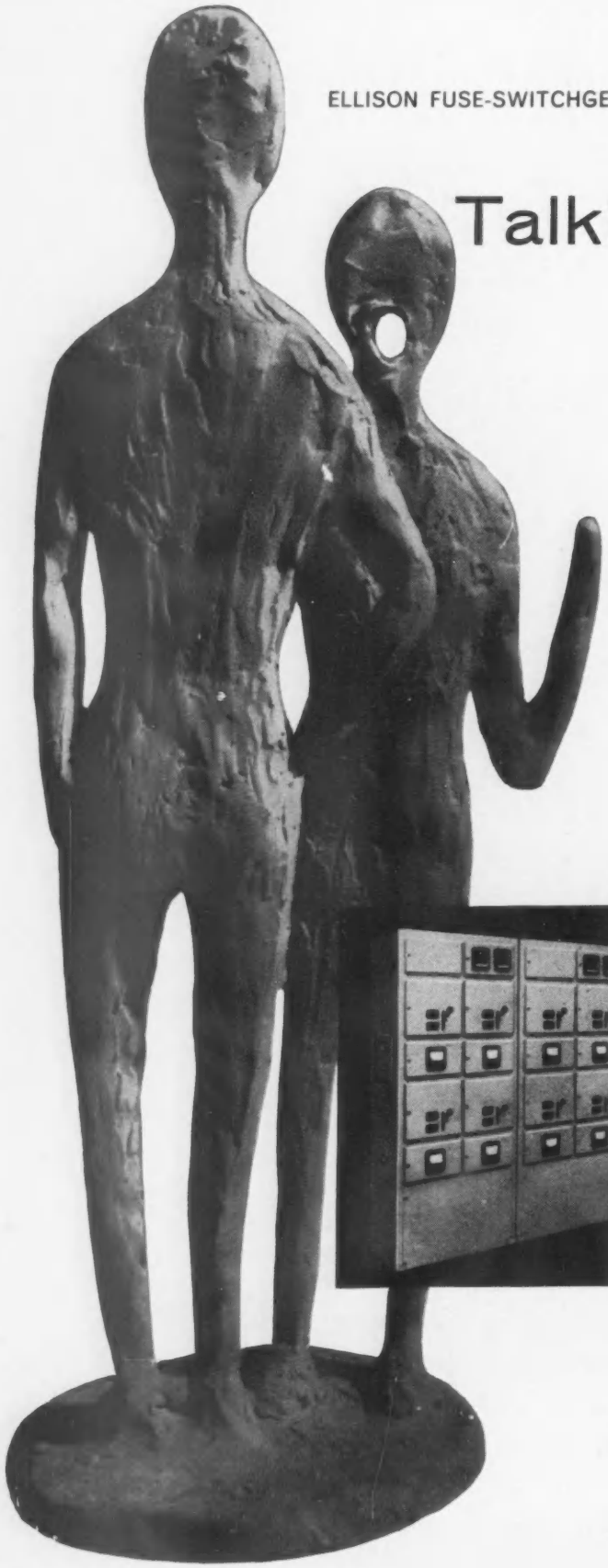
THE POWER PETROLEUM COMPANY LTD

76-86 STRAND · LONDON W.C.2 *(Branches and Depots throughout the country)*



ELLISON FUSE-SWITCHGEAR

Talking technically

It has been said that there are lies, damn lies and statistics. Nevertheless, in choosing switchgear one cannot afford to ignore certain technical data that distinguishes good reliable equipment from others.

For this reason we make no apologies for giving the following information concerning "Ellison" Heavy Duty Fuse-switchgear:

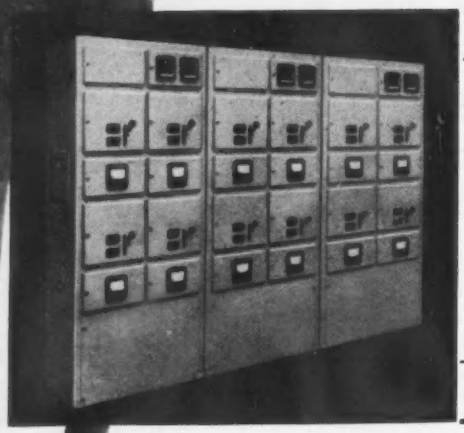
DESIGNED AND TESTED BY US TO B.S.3185:1959 for use with fuses tested to B.S.AC8:1952, Category AC5.

SWITCH MAKING CAPACITY—46,000 amps at 550 volts, ·15 P.F.

SWITCH BREAKING CAPACITY—3 times the rating at ·25/·3 P.F. at 550 volts.

BUSBAR AND CONNECTIONS—comply with B.S.159:1957.

FUSES—Any make of fuse to B.S.88:1952, Form B, can be fitted.



RATED CURRENTS	
FUSE-SWITCH	FUSED
AMP	AMP
100	2-200
200	2-400
300	2-400
400	350-500
600	350-600
Three-pole or three-pole and neutral link	

May we send you further information?

TRADE MARK

GEORGE ELLISON
LIMITED

PERRY BARR · BIRMINGHAM 22B.

869

THURSDAY 20 OCTOBER, 1960
Registered as a Newspaper Volume 138 No. 16

ELECTRICAL TIMES

SARDINIA HOUSE, SARDINIA STREET, LONDON, W.C.2
Telegrams: Equivolt . Estrand Telephone: HOLborn 6016

Dans ce numéro

Experimentation d'un Système de Câble Refroidi à l'Huile 585

Le refroidissement artificiel des câbles dans le but d'augmenter leur rendement effectif peut être effectué par la circulation forcée d'huile au centre du conduit d'un câble rempli d'huile. Au cours de tels essais, de l'huile fut circulée dans un conduit de 12 mm, dans le cas d'un câble ayant 484 mm², puis refroidie dans un échangeur de chaleur. Il fut alors démontré qu'un accroissement de 75% de la charge du courant porté avait été réalisé par l'usage d'un tel procédé, comparé à la méthode normalle de refroidissement. Là où des câbles refroidis artificiellement sont employés, le taux du court-circuit peut devenir le coefficient limitatif de l'augmentation de la charge du courant.

Conception de Transformateurs 591

Des questions d'actualités quant à la conception de transformateurs sont en ce moment mises à l'étude par l'un des gros fabricants, et incluent, entre autres le bruit, les techniques de commutation de prise en charge, le comportement dans des conditions de surtension et la meilleure application qui pourrait être faite des appareils computateurs digitaux au développement de la conception.

L'Ergonomique dans l'Industrie 608

L'Ergonomique, science comparativement nouvelle, étudiant l'ouvrier et son milieu ambiant, fut tout récemment le sujet d'une conférence de trois jours. Comme la machine, le milieu peut être établi sur un plan conçu à l'avance; il n'en est pas ainsi pour les éléments physiologiques et psychologiques se rapportant à l'individu. L'Ergonomiste s'efforce d'étudier les conditions humaines et de les interpréter pour le bénéfice des ingénieurs et des architectes, permettant à ceux-ci d'installer un outillage et de créer une ambiance qui soient tels que la fatigue, l'ennui ou un travail inexact soient réduits, donnant place à un rendement supérieur.

In dieser Nummer

Versuche mit ölgekühlten Starkstromkabeln ... 585

Um erhöhte Belastbarkeit zu erzielen, lassen sich Kabeln dadurch künstlich kühlen, dass Oel unter Druck durch eine zentrale Bohrung des Kabels hindurchgeleitet wird. In einer Versuchsanordnung wurde Oel im Kreislauf durch einen 12 mm-Kanal in einem 484 mm²-Kabel gepumpt und in einem angeschlossenen Wärmeaustauschgefäss abgekühlt. Es stellte sich dabei heraus, dass die Belastbarkeit um 75% gegenüber dem natürlich gekühlten Kabel erhöht werden konnte. Bei der betriebsmässigen Einführung der künstlichen Kabelkühlung dürfte aber die Kurzschlussleistung die erzielbare Erhöhung der Belastbarkeit praktisch begrenzen.

Transformatorbau 591

Die gegenwärtig von einer der grössten Firmen auf dem Gebiete des Transformatorbaus untersuchten Probleme umfassen u.A. Geräuschverminderung, Stufenschalttechnik, Ueberspannungsverhalten und die Anwendung von Digital-Rechengeräten beim Konstruieren von Transformatoren.

Ergonomie in der Industrie 608

Die Ergonomie, eine verhältnismässig neue Wissenschaft, befasst sich mit dem Studium des Menschen in der von seiner Arbeit bestimmten Umwelt. Eine vor kurzem auf drei Tage anberaumte Konferenz war dieser Wissenschaft gewidmet. Sowohl die Maschine wie die Umwelt lassen sich planmässig bestimmen und lenken, die physiologischen und psychologischen Wesenzüge des Einzelmenschen jedoch nicht. Der Ergonomist trachtet die menschichen Faktoren zu ergründen und daraus praktisch verwertbare informationen für Konstrukteure und Architekten abzuleiten, die es diesen ermöglichen sollen, das Arbeitsgerät und die äusseren Arbeitsbedingungen so zu gestalten, dass eine Herabsetzung der Ermüdung, der Langeweile und des ungenauen Arbeitens und dadurch eine Erhöhung der Arbeitsproduktivität erreicht wird.

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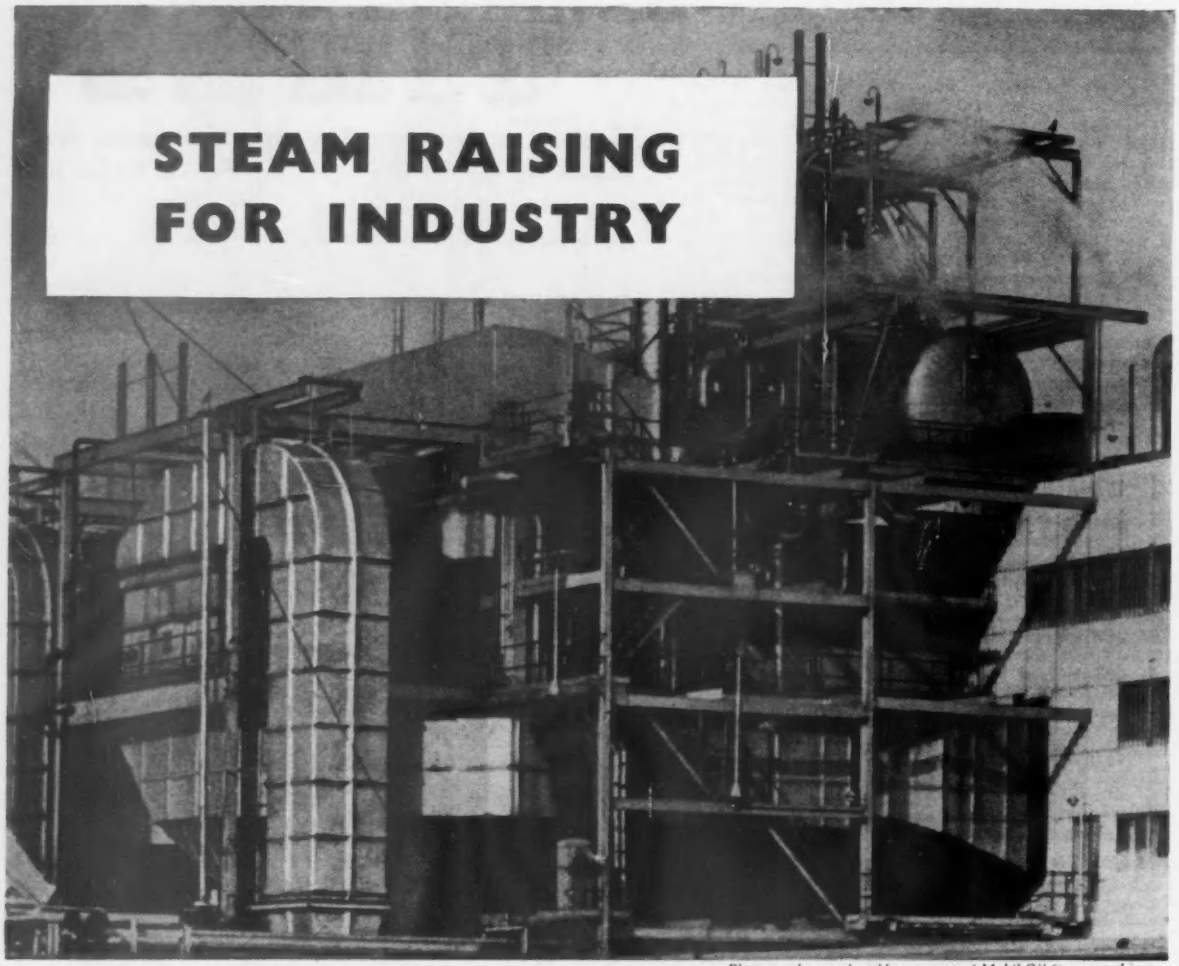

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Comment

APPROVAL GETS GOING

The much-needed approval scheme for the safety of electrical appliances is being launched this week, not with a beating of drums, but with a quiet invitation to manufacturers and importers to submit for approval electrical appliances in four specified classes. On this first group, the approvals board of management has committed itself to firm dates and it is expected that the approvals programmes for other appliances will follow at reasonably close intervals. The initial volume of approval work will be greatly eased by the many appliances that have already passed the required tests for inclusion in the EDA list or Kite mark approval, and these will automatically qualify for the new approval mark. What is more, a testing organisation is already in existence and is being expanded to meet its increased responsibilities. Some delay may be encountered by the lack of suitable standards in certain cases, but the real problem will arise when the trade pipe-lines are filled with approved appliances and the new approval mark has to be launched on the public. Experience with the familiar Kite mark scheme has shown that trouble can lurk in unlikely places. However, the public is becoming conditioned to the acceptance of marks, and with an endorsement anticipated from the Molony committee when it eventually reports, the background of success will be there. And succeed the scheme must if the public is to be shown that the industry needs no outside assistance in keeping its own house in order. This will demand sufficient funds to launch the new approvals mark on the public at the appropriate time, and it is now that the planning must be done.

CHANGING PATTERN IN TARIFFS

At this time, when tariff revisions are so much in the air, it is opportune to study how the revenue per unit from different consumer classes has varied over the past few years. A preliminary study suggested the supply year 1951-52 as a suitable starting point. This was the first year in which the current form of annual statistics was introduced and by that year some of the roughness of pre-vesting prices had been ironed out. By a coincidence, the estimated normal load factor for that year was the same as for 1959-60, although due to load cuts the actual figure was some 4% higher. Since 1951-52 the highest percentage increase in revenue per unit, 27·1%, is for energy sold to industrial consumers, part of which must be attributed to the fall in load factor. The increase on domestic units has been 24·7%, while the lowest increase is that for commercial consumers, 17·2%. Naturally, wide differences exist between the individual area boards, but today, in all consumer

classes, there is less variation between area boards in revenue per unit than eight years ago. Over this period, also, in actual units sold, domestic shows the greatest percentage increase, with commercial as a poor third in load growth. Interesting as these figures may be, it is unwise to draw firm conclusions from them as they represent an isolated period in a continuously changing pattern of prices. None the less, it is difficult to avoid the conclusion that commercial tariffs have not kept pace with those of other consumer classes. Indeed, in the case of South Wales, the commercial revenue per unit was actually less in 1959-60 than in 1951-52. There seems little justification for this falling behind of yield on commercial units; it is a factor that could be kept in mind when tariff changes are contemplated.

LEGISLATION TO BOOST AVAILABILITY

Development of techniques for speeding overhauls, and better information about the time for which plant may be left between overhauls, have done much to step up availability of power station plant when it is most wanted. One of the limiting factors in this drive to increase availability of generating plant during the winter months of potential peak demand is the maximum interval laid down by statute between inspections of boilers. During the war, and since, power station boilers have been exempt from the Factory Acts' hampering inspection-every-year requirement. In the future, if the Minister of Labour accepts the recommendations of an expert committee which reported last week, the period between inspections will be extended from the present 18 months under temporary arrangements, to a permanent 26 months; effectively, every-alternate-year inspection. Further, the same provision is recommended for the heat exchangers of the nuclear power stations at present under construction for the generating boards. These decisions of the committee will be welcomed by the supply industry for the flexibility in planning they bring. It is notable that they are occasioned not so much by any inherent superiority in large boilers, but rather by the confidence that the electricity boards and the large industrial undertakings, which alone operate large boilers, pay the closest attention to maintenance and operating techniques and to the preservation of the highest standards of water purity, points to which the committee attach particular importance. Indeed, they specifically recommend training of boiler operatives and note with obvious regret that it is only variations in circumstances from installation to installation that prevent them from making recommending regulations covering feed water purity.

KEEPING TRANSFORMERS QUIET

There is increasing concern amongst the public with all aspects of noise, and the generally quiet electrical industry suffers from the increased sensitivity which results. Currently, there is concern about transformers, both in the distribution networks and in large substations. Use of cold-rolled, grain-oriented steel for cores, with lower losses making possible higher flux densities, is accompanied by more magnetostriction, and increased noise is the result. In the fundamental work on the problem being carried out by one manufacturer, whose works we visited last week, the outstanding problem thrown up is the variability of batches of steel strip all of the same nominal grade. The subject is complicated, as dim memories of physics experiments remind us, by the variation in sensitivity of the human ear to sounds of different frequencies. Transformer core vibrations at harmonic frequencies can be far louder for a given energy or sound pressure level than those at the fundamental. Until transformer steel makers find some means of making the cold-rolled product homogeneous in its magnetic properties, or at least of controlling variations, the more elegant approaches to noise suppression are not available to the transformer manufacturer. However, despite the unfortunate effectiveness of oil as a noise transmitter, there are some useful ideas coming into service for economical enclosures and the avoidance of fortuitous amplification of noise due to particular forms of mechanical construction. These should keep noise nuisance down at reasonable economy and avoid the position where the public imagine every transformer is noisy because of what they have heard of a few isolated, well-justified complaints.

NATIONAL PRODUCTION FOR GAS

The 1959-60 annual report of the Gas Council is not so ebullient as those of a few years ago. Two years of deficits can have a damping effect, particularly when most percentage growth figures are negative. None the less, the industry is planning ahead and the most significant factor is the setting up of a production policy committee responsible for planning gas production on a national basis. This follows from the new methods of production that are being developed by the Council as well as new sources of gas, which will require a scale of operation beyond the needs of individual gas boards. Such techniques will clearly demand the building of the long-discussed gas grid. One of the factors is the direct import of methane which has been proved possible technically. Studies of the economics are now being made and these appear sufficiently good to capture the interest of the Royal Dutch-Shell oil group. On the selling side, the increasing use of gas in industry is the main bright spot of the report, but great things are hoped from ducted heating systems, which are the gas industry's reply to electric floor-warming. Operating experience on trial installations is reported satisfactory and some 2,000 flats in course of construction will be provided with this method of heating. So the gas industry still shows the commercial resilience that should keep electricity on its toes.

Meteor

This week's quick summary of electrical news faces advertisement page 20

An experimental oil-cooled cable system

by S. C. Chu,* B.Sc. (Eng.), A.M.I.E.E.

ARTIFICIAL cooling has been applied to many types of electrical machinery, and it is quite common for alternators and transformers to achieve very large ratings coupled with high efficiency in the use of materials by this means. Owing to the continuous increase of power demand, cable engineers have been devoting more attention to the use of forced cooling of power cables in order to overcome the difficulties due to limited space and similar factors; that is, to permit transmission of more energy with a given cable size.

In power stations and substations, where very large currents have to be considered, it is often necessary to install large groups of cables within confined spaces. Manipulation of large copper sections, together with the siting of numerous terminations, and supports, can be a serious problem. In securing a solution, safety margins may be reduced through severe bends, high ambient temperatures, mutual heating, and increased risk of damage during maintenance, etc. Where several buried cables converge on to a station, costs are increased considerably by the allowances which have to be made in copper cross sections, because of mutual heating. In extreme cases, up to three times the normal conductor cross section may be required.

In underground cable systems, load capacity of the cables can be increased during peak periods or the number of cables be reduced with artificial cooling. Also, where there is large variation in soil thermal resistivity along the cable route, the possibility of "hot spot" temperatures cannot be entirely overlooked. Artificial cooling can alleviate this problem.

A variety of cooling methods have been experimented on and applied to power cables.

Cable Cooling Techniques

Artificial cooling of cables has been considered more fully by a number of investigators since 1951. Their methods can generally be divided according to whether the coolant is introduced externally to, or internally within, the dielectric (Fig. 1).

For the external cooling, Burrel, Falcone and Roberts[1] have studied forced-air cooling of station cables in ducts, and a few practical applications have resulted in the USA to overcome rating limitations in existing cable installations.

Buller[2] has developed a number of practical formulae and graphs for calculating the temperature at any point along a cable route using different methods of cooling for pipe cables or cables in ducts or in tunnels.

Giaro[3] introduced the term "thermal efficiency" to assess the relative merits of different cable installations by air cooling. In his recent paper[4] mathematical and experimental investigations were given on temperature rise of cables of 1 to 15 kV installed in large gallery cooled by forced ventilation.

Gillette[5] has found that by circulation of oil in a 200 yd length of 69 kV pipe-type cable and through an air-cooled heat exchanger, the number of cables can be reduced from three to two.

Brodicky[6] has described two installations of 12 kV and 66 kV, respectively, in which water was forced through the ducts in which the cables were installed, and no adverse effect on the cable sheaths was found.

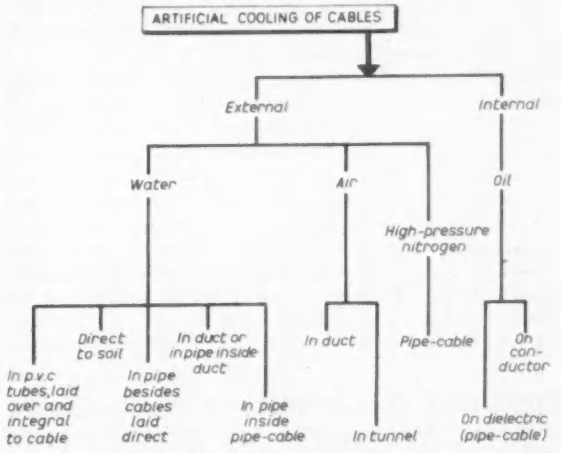

Fig. 1. Suggested techniques for artificial cooling of power paper cables

Several attempts have been made successfully to reduce the "hot spot" temperatures owing to variations in soil thermal resistivity along the cable route. Fink has studied the use of backfill in place of soil known to have poor thermal properties.[7] Lowering of thermal resistance by continuous moistening of the surrounding dry soil can obtain a reduction of 10° to 15°C of the cable.[8] Automatic oscillation of oil back and forth over a 200 yd 138 kV pipe cable by differential pressure system using float switches is also found practicable in lowering "hot spot" temperature.[9] For pipe-type compression cable, circulation of gas has been applied recently in Canada to eliminate the "hot spot temperature.[10] In this case the conductor temperatures along the entire route of about ¼ mile can be evened out to within 5°C, as indicated by a temperature telemetering system.

Circulation of water through polythene pipes laid alongside 115 kV oil-filled cables laid direct in the ground has been applied recently in Canada, thus increasing the current rating of the cable by 50%.[11,12] Similar order of rating improvement is also possible on 275 kV pipe-line cable greater than 1 km length cooled by water, as discussed in a recent paper by Sutton and Morgan.[13]

In this country, small p.v.c. tubes of segmental shape laid over the reinforced tapes of 132 kV oil-filled cable have been used for passing through cooling water in

* Mr Chu was formerly with Standard Telephones and Cables Ltd., and is now with Enfield-Standard Power Cables Ltd.

order to increase the rating of the cable.[15] It is claimed that 50% increase above the normal load can be obtained.

In the systems described above, the major heat source is separated from the cooling medium by the relatively high thermal resistance of the cable insulation.

The media considered for such methods of cooling are air, water or oil. For cables in ducts, water cooling is a more effective cooling medium than air. The disadvantage is that it is likely to be costly and difficult to install, and may eventually cause corrosion or even erosion troubles.

Circulation and cooling of the pressure medium in a pipe-type cable is more effective with oil as heat transfer medium than with high-pressure gas.

It is evident that, for relatively short cable lengths, the most effective method of cooling should be to remove the heat directly from its main source of generation, i.e., by circulating coolant internally directly onto the conductor. For oil-filled cables, this can conveniently be achieved by circulating cooling oil through the central duct. Experiment on an internally-circulated-oil-cooled cable system was first pioneered in 1951-52 in this country, based on a 11 kV typical power station installation. The basic experiment and the practical design of a proposed installation[16] described later will form the principal theme in the present article.

Since then the application of similar technique was extended to extra high voltage oil-filled cables up to 500 kV.[17,18] With the circulating oil degasified, the cable dielectric strength can be improved by eliminating any gas evolved.

Internal water circulation in plastic cables with a hollow core conductor for loading heavy currents from generators to generator/transformers and for carrying large currents associated with nuclear apparatus has also been investigated recently.[14] Owing to lower dielectric strength of the plastic insulation, the thickness will be greater than that of impregnated paper for the same working voltage.

Preliminary Considerations for Internal Cooling

Initially, the conductor size of an internally-circulated-oil-cooled cable should be chosen with reference to electrical, mechanical and economic considerations.

Electrical design will usually limit the maximum working conductor temperature to 85°C and the maximum temperature during a short-circuit to 120°C. Since such cables will usually be installed close to alternators, the short-circuit rating may often be the determining factor; in such cases it may be preferable sometimes to reduce the maximum conductor working temperature to a value below 85°C. Fig. 3 shows the variations in short-circuit rating for a typical cable at different maximum conductor working temperatures.

It is to be noted that any reduction in copper cross section will increase the losses which, together with the power consumed in the cooling system, will result in higher operating costs.

Mechanical considerations will dictate the choice of cooling duct size to ensure a reasonable pressure drop along the cable length. The maximum cable internal pressure is usually limited to 15 lb/sq in. for a cable without reinforcing over its sheath, and to about 75 lb/sq in. for an ordinary reinforced cable. A lower pressure drop, i.e., a lower fluid resistance of the duct is to be preferred, since it permits the use of a simple centrifugal pump in the cooling system.

It is now necessary to calculate the quantity of oil flow required through the central duct at any load for a given conductor section, length of cable and pre-determined inlet and outlet oil temperatures at any ambient temperature. The theoretical cooling equation can be derived by equating the heat generated in the cable with the heat dissipated radially to air through the dielectric and the heat removed by oil flowing axially through the duct.

Thus:

$$q = L \Big/ \left[hG \log_e \left\{ (wG + T_a - T_i) \Big/ (wG + T_a - T_o) \right\} \right]$$

where q = Quantity of oil flow, litre/sec.
L = Length of cable, cm.
h = Specific thermal capacity of oil, watt/sec/litre/°C.
G = Total thermal resistance, internal and external to cable, °C watt/cm.
w = Average total loss of cable, watts/cm.
T_a = Ambient temperature, °C.
T_i = Inlet oil temperature, °C.
and T_o = Outlet oil temperature, °C.

Pioneer Experiment

An experiment was made to confirm the method and calculations based on an installation in an actual power station to which the system seemed economically suited. There were 24 1·25 sq in. 11 kV single-core solid-type cables serving a double alternator set. The full load current of each alternator was 1,445 amp. The arrangement was two cables in parallel for each phase, and phase to neutral. As the space was congested it was difficult to employ satisfactory cable terminations. Oil-cooled cables of small cross section were suggested as a replacement in order to reduce the number of cables required by half, i.e., one oil-cooled cable to replace the two solid-type cables. By using cables of the oil-filled type, a much higher electrical factor of safety would also result. The ambient temperature was 35°C.

Initial calculations indicated that 12 single-core 0·75 sq in. internal-circulated-oil-cooled cables would be suitable. With copper conductors such cables would carry about 60% of the full-load current without artificial cooling. The normal 0·2 second short-circuit rating of this cable is 81,000 amp based on a maximum conductor working temperature of 85°C, and maximum conductor temperature under short-circuit of 120°C.

A basic experiment was carried out on the 0·75 sq in. cable with a 12 mm central oil duct, and with about the same length as the actual cables required. The cables were installed in trefoil formation in a high ambient temperature, similar to that obtaining on site. The ends were suitably terminated to permit an oil feed into the hollow conductors.

The hot oil leaving one end of the cable was passed through a heat exchanger and an oil filter, and returned to the other end via flow-measuring meters. A pressure tank was used to accommodate the expansion of oil in the system and to provide a basic pressure which, during the test, was 10 lb/sq in. In the experiment, cooling water was supplied direct to the heat exchanger from the town main, but alternative means of supply could, of course, be used in the actual application, such as tapping from an existing condenser circulating water supply.

The tests were made with the oil inlet and outlet temperatures maintained as nearly as possible to 50°C and 85°C, respectively; the latter was fixed by the usual maximum conductor working temperature for this type of cable, and a 35°C drop seemed a reasonable one to expect from a heat exchanger. The loads were varied between 1,200 and 1,600 amp and the rate of oil flow and water flow in the heat exchanger adjusted to obtain the above oil temperatures.

It was found that the actual values of oil flow required agreed fairly closely with the calculated values as shown in Fig. 2. Owing to the limitation of the pump used, the maximum oil flow obtainable was 2·8 litres/min/cable which corresponds to a current loading of 1,600 amp. It should be noted that the limit of streamline flow (i.e., that the Reynolds number is less than 2,000) is about 5 litres/min/cable. Had this flow been applied and the cable loaded to 1,445 amp as required under the actual operating conditions, the maximum conductor temperature could have been reduced to 65°C and the short-circuit rating of the cable thereby increased by about 25%. It is to be noted that this result can also be achieved by reducing the inlet oil temperature.

The maximum permissible length of the cable based on streamline oil flow limit of 5 litres/min/cable is 68 yd, which is far in excess of the route length required for the particular installation.

It can thus be concluded that within the limitations of the testing facilities, the current-carrying capacity of the 0·75 sq in. cable can be increased to 1,600 amp by internal oil circulation, i.e., about 75% over its current rating with natural cooling, with still a considerable margin in hand.

Proposed Installation

A practical scheme was designed for the alternators in question based on the principles employed in the experimental project, and with the addition of the usual protective devices. The arrangement of the oil circuit is shown diagrammatically in Fig. 4. Duplicate pump/cooler units are provided against the event of failure and to avoid shut-down during servicing. The motor pump units are of the centrifugal type, hermetically sealed, with the motors designed to run in oil.

A copper pipe of 1 in. diameter conveys oil to the alternator ends of the cable, and the flow in each branch is adjusted initially by a metering valve to give the same outlet temperature at the remote end of each branch. Similarly, oil is delivered into the neutral cables. A "snap" type thermostat is fitted to each cable sheath at the outlet points to give an alarm should abnormal temperature rise occur due to a restriction in the oil feed.

The system operates at a static pressure of about 10 lb/sq in. without load, and control is by pressure rise in the system, this pressure varying with the cable temperature within limits which can be determined by the pressure/volume characteristics of the static pressure tank. The first pump is therefore set to operate at the designed maximum temperature, and the second one a few degrees higher. Operation of the second pump gives an alarm indicating that the first pump has failed to start, or that an abnormal temperature rise has occurred. Separate oil and the water coils are used in the cooler, and cable oil is used as the heat transfer medium. Any leakage from the system will result in operation of the low oil pressure alarm and leakage from either the oil or water coils in the cooler will raise the pressure of the surrounding oil, which does not form part of the main system and will operate the high pressure alarm incorporated in the cooler. If additional safeguard is deemed necessary in the cooler, an electrical leakage detector has been evolved which indicates traces of moisture in the oil.

Cost

As with any other systems of artificial cooling of cables, an internal-circulated-oil-cooled cable system involves extra cost due to oil circulating pumps, coolers and ancil-

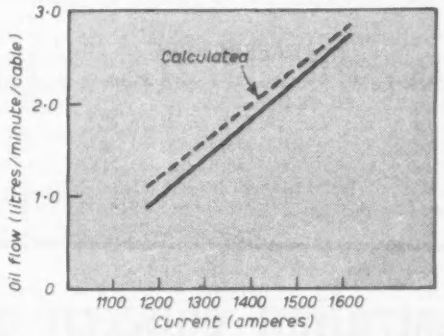

Fig. 2. Experimental results with an internally-circulated-oil-cooled cable with 0·75 sq in. copper conductor. In the tests oil inlet and outlet temperatures were maintained at about 50°C and 85°C, respectively

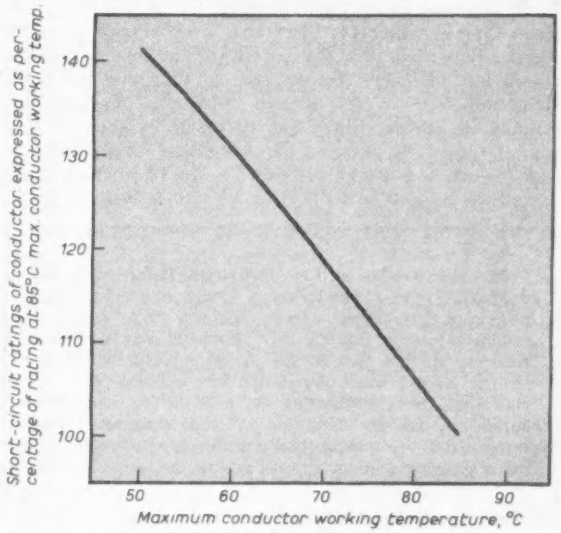

Fig. 3. Comparison of short-circuit ratings of conductors at various maximum conductor working temperatures. (Note: maximum conductor temperature during short-circuit is taken as 120°C)

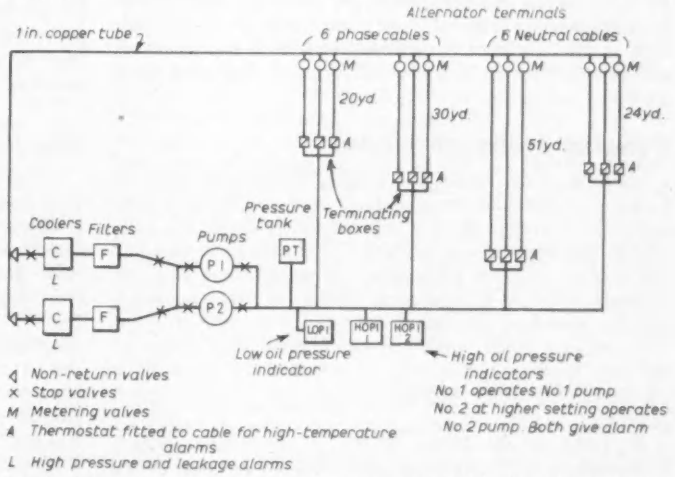

Fig. 4. Proposed oil-cooled cable system for typical 11 kV alternator installation

lary equipment, but this will normally be largely compensated by the reduction of cable costs. Exact comparison will depend on individual cases and requirements and current relative material costs.

Acknowledgments are due to Enfield-Standard Power Cables Ltd. for permission to publish this article.

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Australian concern over U.K. Plant Deliveries

A WARNING that Britain would lose valuable contracts for electrical plant unless prompt delivery could be guaranteed was made by Sir Eric Harrison, High Commissioner for Australia, proposing a toast to the electrical industry at the Electrical Engineers' Exhibition dinner last Thursday. He pointed out that with the rapid industrialisation of the eastern provinces of Australia, demand for electric power was increasing by about 15% a year. To meet this demand the Australian supply industry had to work to a strict time-table. For this reason they could not afford projects to be held up by late delivery of plant.

BEAMA Replies on Late Deliveries. Referring to the Australian High Commissioner's speech at the Electrical Engineers Exhibition dinner, BEAMA have issued a statement saying that Sir Eric Harrison was doubtless referring to that part of the Snowy Mountains hydro-electric project when completion was delayed owing to civil engineering difficulties. As a result of these difficulties the delivery dates for electrical equipment were revised and the company responsible for supplying the main generating plant complied with the revised dates.

There had been cases in the past of vital supply reinforcement schemes, such as the Snowy River project, being delayed by late arrival of plant from British manufacturers. Sir Eric quoted two examples, one where delivery was six months overdue and the other as much as 18 months. This tardiness compared unfavourably with the record of continental suppliers, whose deliveries, if anything, were ahead of schedule.

Potential Australian Market

Looking to the future, the High Commissioner went on to say that Australia was a large country with an enormous industrial potential. Here was a market in which the Australian Government was anxious for Britain to have a fair share in competition with other countries. There was, for instance, a 760 MW generating station for which contracts will be placed at the end of this year. The decision as to who will get these contracts will depend largely on the delivery question, as it will for contracts covered by a further £13 million expenditure on the Snowy project planned for next year.

Replying to the toast, Mr F. H. S. Brown, deputy chairman, CEGB, admitted that the Generating Board had also suffered from late delivery of plant by British manufacturers, but that over the past two years the situation, in this country at least, had improved considerably.

Continuing on a different note, Mr Brown said that the CEGB as a monopoly buyer had a joint responsibility of not only supplying electricity to the country as cheaply as possible, but also of ensuring that British manufacturers were kept in the van of generation progress. To achieve this aim the Board was actively pursuing every line of technological advance. Thus, by keeping pace with these advances, British manufacturers would be in a strong position to supply the needs of overseas countries for the latest equipment.

Exhibition Prospects

Speaking of the future expansion of the Electrical Engineers' Exhibition, Mr R. F. Mathieson, chairman of the exhibition company, said that this was limited by the space available at Earls Court. The exhibition had grown to such an extent since its inception ten years ago that there was actually a waiting list for stand space for the 1961 event. With progress made by ECM and its possible integration with EFTA, there might well be a demand for a truly international exhibition in the future. This was clearly impossible under the existing arrangements at Earls Court, and in any case the organisation of an exhibition on such a scale was rather beyond the scope of private enterprise. It was more a matter to be taken up by central government in co-operation with local authorities. Referring to the dinner, Mr Mathieson said that its purpose was to give advance publicity of the exhibition to both potential buyers and exhibitors.

Plea for H.P. Stability

Concluding the after-dinner speeches, Mr W. J. Bird, chairman of BEAMA's Domestic Appliance Division and a director of GEC, expressed the view of British manufacturers concerning h.p. They were not demanding complete lifting of restrictions but they did want freedom from Governmental chopping and changing of h.p. policy. Mr Bird suggested that optimum h.p. terms acceptable to the appliance industry might be 10% down with 3 years to pay. Turning to future trading prospects of the industry, he saw no reason why annual turnover should not be trebled to reach a ceiling in the £1,000 million region. Finally, Mr Bird paid tribute to the successful growth of the exhibition, but pointed to the danger of its original conception being stifled by it becoming too unwieldly.

Readers Views

Correspondents writing under pseudonyms are asked to submit their names and addresses in confidence to the Editor

Responsibility on Sites

FURTHER to *Megohm's* comments on the responsibility of general contractors in the ELECTRICAL TIMES, 6 October, the 2½% discount allowed to the main contractor in accordance with the RIBA contract is not intended to cover any services or attendance. It is purely a discount for cash, that is, payment within 30 days. This is not generally understood by electrical contractors and on many occasions I have known them complain over delays in payment and have always advised them that they are perfectly entitled to refuse the 2½% discount if they do not receive payment within the stipulated time.

The above requirement applies to all nominated sub-contractors and there is a similar obligation on the part of nominated suppliers, but in this case the cash discount is 5%.

Attendance, cutting away, unloading, etc., ought to be an item in the Bill of Quantities. The specification should state precisely what the general contractor's responsibilities are, and a copy should be sent to the quantity surveyor in order that they may be measured or allowed for in the main contract in some way.

If no item has been included for this work in the Bill of Quantities, the general contractor is quite entitled to refuse to carry it out, unless he is paid for it. Although the position should be quite clear, many people do not read the small print in the contract.

The exceptional case mentioned, where the general contractor has cut through conduit and refused to pay for replacement, can be dealt with only by the electrical contractor refusing to carry out repairs unless the general contractor undertakes to pay for them. If the electrical contractor withdraws labour and the main contract is held up, it is the general contractor and not the electrical contractor who is primarily responsible to the employer.

P. Jay, M.A.,
PETER JAY AND PARTNERS LTD.,
LONDON, W.1.

Building Contractors and Electrical Work

READING *Megohm's* comments on the need for co-operation between building and electrical workers on a site brought to mind a visit recently paid to my son's new house at Guildford. He has been having not inconsiderable trouble in getting the clerk of works to remedy various faults connected with the building, but having had similar experiences in my younger days, I was able to indicate other matters which required attention.

There is a strong trend to ensure that the electrical work done in new buildings shall be well done and safe. If, however, the builders' men adopt the apparently fairly general attitude of "I couldn't care less" (I have noted it in the north as well as in the south) and the contractors themselves permit shoddy work, the better work of electricians will be nullified and they will be included in the general complaints about the building.

Is there not some way in which the really good man can be protected from becoming involved in the shoddy work of others? "Control" is an unpopular word. Yet it is control which saves lives! The selfish driver hates control but, thank goodness, we still retain our policemen and the laws to curb his selfishness. So why not control over bad workmanship, which is, in practice, pure swindling! Could not the powerful electrical trade and its associations campaign unitedly against becoming involved in ways such as *Megohm* has mentioned?

J. W. McDonnell,
STOCKPORT, CHESHIRE.

Electrode Boilers for Offices

A RESUME of the CEGB report on heat pumps and cost of heating in power station office blocks was published in your issue of 8 September, but without comment on the figures produced.

The figures and conclusions on the heat pump show what one might expect, and the real case for the heat pump would be for off-peak use in conjunction with an electrode boiler and thermal storage.

On the figures produced for electrical heating by floor-warming and electrode boiler with thermal storage, the committee should release further information to show the make-up of the annual running and operating costs.

The figures given in the full report of the CEGB committee, for electrical heating by floor-warming and electrode boiler with thermal storage, do not show in full the make-up of annual running and operating costs. Indirect calculations* throw serious doubt on the overall figures derived, and reproduced in Table 3 of the ELECTRICAL TIMES summary.

For a floor-warming system, the figures imply an annual consumption of nearly 3,000 kWh/kW of calculated heat loss, whereas experience shows the consumption is usually in the region of 2,240 kWh/kW. In the case of the electrode boiler with thermal storage, the figures seem even more ludicrous. Instead of the figure of £2,862 for annual operating costs quoted, on a basis of the maximum possible calculated consumption the annual operating cost including capital charges should be less than £2,000.

It would seem that the committee chose a building where the electrode boiler and thermal storage plant were housed in a separate boiler house away from the building to be heated, and this seems a foolish comparison with a building where the heating plant is contained in that building. It is like trying to compare the economics of a machine tool with a self-contained electric drive, with a machine tool driven by belting from overhead shafting with a motor some 100 yards away.

In their conclusions, the committee state: "For the ordinary run of commercial buildings of sizes in the range 200,000 to 500,000 cu ft, off-peak directly embedded electrical floor-warming compares favourably in overall annual operating costs with any other form of heating." For office buildings occupied eight to ten hours per day the committee's conclusions cannot be substantiated. This would appear to be outside their terms of reference, as commercial buildings such as office blocks are not generally heated 24 hours per day, and their statement is erroneous and misleading.

* Mr Edwards has sent us the full calculations supporting his argument, which are too lengthy to reproduce here. He also gives supporting calculations based on experience with an electrode boiler for heating the North Eastern EB offices in Newcastle.—EDITOR.

Any new projected CEGB offices which only require heating during normal office hours can be heated much more cheaply by electrode hot-water boiler and thermal storage than by embedded floor-warming. On the figure of 448,000 B.Th.U's per hour the unit consumption for hot-water thermal storage for heating ten hours per day, five days per week, should not exceed 125,000 units during the normal heating season. The cost at 0·85d per unit would be £443 plus capital charges and maintenance.

To delete the electrode boiler without thermal storage because it is "on-peak" load is a little unfair to the South of Scotland Electricity Board where their off-peak No. 2 tariff accommodates such loads. The storage is in the pipework and radiators and allows a two-hour restriction on peak period twice per day.

J. C. Edwards,
DIRECTOR, BASTIAN AND ALLEN LTD.,
HARROW, MIDDLESEX.

Isolators for Fault Closing

IN your editorial article concerning isolators, on page 506 of 6 October issue, you rightly point out the possible danger of using isolators for reclosure of circuits. If the practice is widespread—and it seems to be common in medium and h.v. operation—the simplest remedy is to incorporate fault-closing as a requirement and a test duty under BS 3078. The electricity supply authorities, in the UK at least, have for many years been aware of the necessity for medium and h.v. isolators to have fault-closing capacity, and they have insisted on the point to manufacturers. In consequence, many of the isolators on overhead transmission lines in this country *are* capable of fault-closing.

For the sake of safety it may be that all isolators ought to be capable of fault-closing as a matter of course. In that case we would support a change to the standard specifications. We would not welcome another new term, "isolating switch," into this field whose terminology is far from simple and not at all standard.

D. A. J. Oxley,
M.M., ASSOCIATE I.E.E., M.I.PROD.E.
MANAGING DIRECTOR, SWITCHGEAR AND EQUIPMENT LTD.
BANBURY.

Switches for the Aged

I AM in complete agreement with the remarks and suggestions made by *Megohm* in last week's ELECTRICAL TIMES.

There was an old lady who lived in a small bungalow at Witcombe in Gloucestershire; this bungalow was one of a group built specially for old persons. She was an old friend of my family and one day, on a visit, I found that, if anything, the sockets and switches were sited more inconveniently than one usually finds.

The sockets were fixed right near the floor, there was no switch and I was very angry to see this poor old lady fumbling about pulling plugs in and out in order to disconnect an appliance or a lamp.

In addition to the foregoing, the cooker control unit and the main switch were out of reach, but it is doubtful if the old lady would have had the strength to operate them had they been within reach. In the bedroom was a centre light, controlled, if my memory serves me, from the adjoining living room; a socket (unswitched) on skirting board; no bedlight; no provision for controlling the solitary centre light from the bed.

Owing to the sparseness of sockets, she was obliged to use one of those iniquitous socket-adaptors—one of the pests which the ring system was designed to obviate, so we were told.

I see no reason why sockets should not be fixed 18 in. from the floor, this would preclude stooping (almost), but there is a good case for maintaining switch height at 4 ft 6 in. or even slightly higher, especially where surface type is concerned, for it is possible to give oneself a nasty jar when passing someone in a narrow corridor, etc. Also, at that height they are safe from being damaged—or obscured—by chair backs. But for these reservations, I would rather have them at elbow height (3 ft 6 in.).

R. St.C. Ison,
CHELTENHAM.

Boiler Inspection Recommendations

EXTENSION to 26 months of the interval between statutory inspections of power station boilers is recommended by the Ministry of Labour Advisory Committee on the Examination of Steam Boilers in Industry (the Honeyman Committee) which reported last week. The five-man committee is in general agreement that although the existing 14-month period should be kept for smaller boilers, an extension to 26 months should be permitted for water tube boilers of more than 50 klb/hr capacity and also for boilers of 25 klb/hr rating where the total capacity of all such boilers on one site exceeds 100 klb/hr. Four members of the committee wanted to make the extension automatic, but one thinks it should be subject to approval by H.M. Chief Inspector of Factories.

The committee was set up in 1958 to consider existing legal provisions for the examination of steam boilers in the light of modern developments and also with reference to nuclear installations. There has been an every-14-month requirement for boiler inspection since the 1901 Factory Act, but during the war years the extension to 18 months was permitted for certain specified types of boiler. Large power-station boilers were amongst these, and the extension has continued in various forms since. The 1959 Factories Act did not include specific requirements for boiler inspection, but made provision for the Minister of Labour to make regulations governing boiler examination.

Evidence before the committee supported the idea that all boilers to which the Factories Acts apply should be thoroughly examined within 14 months of coming into use. The committee feels that for smaller boilers annual inspection (implicit in the 14-month period) should continue, but that evaporative capacity was a reasonable criterion for deciding which type of boiler merited relaxation. There is agreement that 50 klb/hr sets a limit above which boilers are likely to be used only by the CEGB and other large industrial concerns. These may properly be expected to maintain the high standards of maintenance and operation and feed water conditioning which will be required for every-other-year inspection.

Apart from the recommendations noted above, the committee suggests an initial inspection of all boilers between eight and 14 months after initial installation. In addition, the 14 months inspection interval should apply to all boilers after they are 21 years old.

On the question of nuclear power stations, the committee recommends that the 26-month interval after the initial inspection should apply to the heat exchangers on the power stations now being built for the electricity supply industry. Requirements for more advanced types should be the subject of discussions between the Ministries of Labour and Power, and the UKAEA, before the necessary licence is granted for operation of the station.

Electrical Times, 20 October, 1960

Progress in Transformer Design

NEW E.E. Co. £3 MILLION WORKS

CONSTRUCTED and equipped to manufacture power transformers up to the largest sizes envisaged in the coming years, the new English Electric transformer factory at Stafford was last week shown to engineers from Britain and overseas attending an EE Co. symposium on transformer design. The new factory covers 245,000 sq ft and cost £2 million to build and £1 million to equip. It is served by a 40,000 sq ft four-floor office block providing the necessary accommodation for design and commercial staff.

Planning for the new factory was commenced in 1955 and building started in 1957. Up to the time the factory was planned, the largest units manufactured had been 120 MVA auto-transformers. Now the range shown in Table 1 is envisaged for the next decade. Transportation difficulties will limit the physical size and weight of transformers. Layout of the new factory was designed with this in mind, and it was decided after workstudy that provision of crane capacity to lift 400 tons 60 ft high would give an economical layout for manufacture and testing with minimum wasted effort in shifting the transformers. The fundamental concept is that large transformers should be completely built at one site and then lifted complete with bushings over any other transformers in the shop to the final test area.

In its present form the factory is self-contained except for some metal-cutting operations, which it was decided to isolate because of the danger of metal particles getting into the coils. The only metal-cutting carried out is the slitting of core steel and a few special processes carried out in enclosures with walls going up to the roof.

The factory is divided into six bays, one of which is a high bay equipped with two 200-ton cranes, which are together capable of handling the largest transformers and which can achieve most lifts separately. There is another bay for building smaller transformers. Both these erection bays have ready access to test facilities for heat runs and over-voltage tests.

Impulse Generator

At one end of the high bay is the impulse generator, designed and built at Stafford by EE Co. staff and claimed to have the highest voltage (4.800 kVp) in Europe, and the highest energy (346 kW-seconds) in the world. The impulse generator uses the Marx circuit and the design object was to reduce generator inductance to a minimum to give the greatest possible range of impulse wave front time constants. In practice, this has meant combining the lowest possible number of stages with a high operating voltage, and the generator as built has 12 stages charged at the unusually high value of 400 kV.

Each of the 12 stages has an individual capacitance of 0·36 microfarads in three capacitors in parallel. Charging equipment comprises a transformer feeding a voltage-doubling circuit, controlled in turn by a magnetic amplifier with a feed-back circuit from a resistance divider on the 400 kV line.

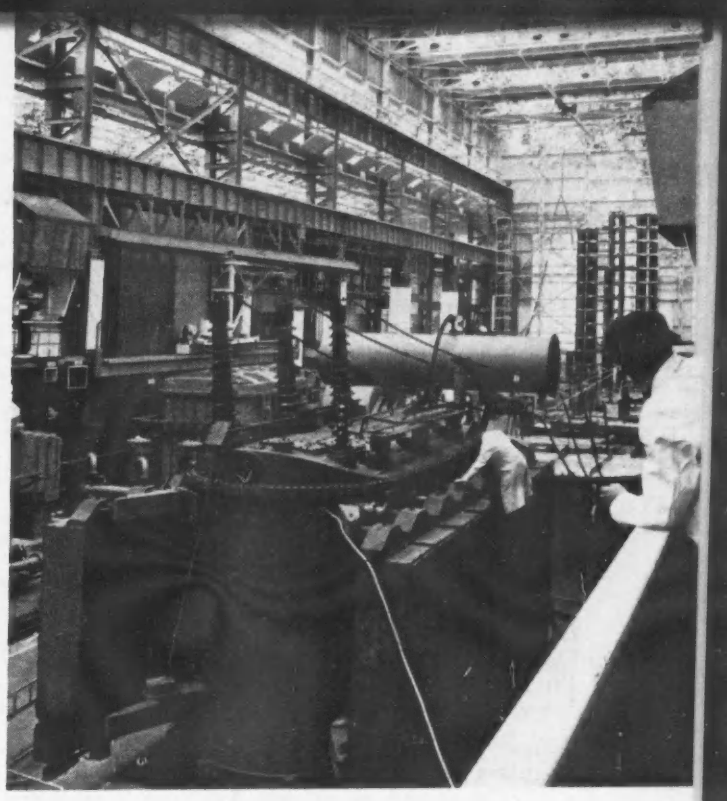


Fig. 1. 200 MVA transformer being prepared for test in high bay at new EE Co. works; 4·8 MV impulse generator in background

Setting up the generator for test is facilitated by use of a recurrent surge generator constructed as an analogue of the impulse generator; this, of course, working at a low voltage. The recurrent surge generator is connected to the transformer, adjusting the characteristics of the circuit until the required wave form is obtained.

Rotating Plant

Other test equipment in the factory, installed in a bay alongside the high bay, provides for complete testing, including full-scale heat run of a 600 MVA transformer. The principal equipment consists of four 10 MVA alternators driven by d.c. motors (to give variable frequency) combined with 42 MVAr of capacitors. One of the alternators may be synchronised to the incoming 11 kV supply and used as a synchronous motor to drive its associated d.c. machine, so giving a variable d.c. supply for testing reactors. There are two 1 MVA machines used to give a variable frequency auxiliary system, and a third set rated at 7·5 MVA used in over-potential testing at frequencies at 1,000 and 2,000 c/s.

Test transformers in separate cells adjacent to the machine hall give voltages between 11 kV and 80 kV in

Table. 1. Foreseeable transformer requirements

Voltage ratio	Size	Line load current HV	Line load current LV	Short Cct current LV	Weight
kV	MVA	A	A	kA	lb × 10^3
150/33	150	575	2,630	17·5	225
300/20	600	1,160	17,300	102	490
400/20	800	1,160	23,100	136	620
500/20	1,000	1,160	28,900	170	750
500/300*	1,500	1,730	2,880	24	620
500/400*	1,500	1,730	2,160	21·6	420
400/300*	1,250	1,800	2,400	24	400
300/150*	500	960	1,920	16	350

* These transformers will be auto-transformers with a tertiary delta winding.

BRITISH TRANSFORMERS IN UNITED STATES

AMERICAN technical papers have widely reported, during the past year, trouble with breakdown on some large English Electric transformers. During our visit to the new English Electric Co. transformer works, a spokesman said that such breakdowns were largely connected with the use of the sealed gas-cushion arrangement, which for some time has been favoured by the American supply industry as a preferred alternative to conservators. English Electric had to comply with US specification requirements by designing for the use of this system, despite misgivings about it. Now research has shown that the gas-cushion technique results in evolution of gas bubbles which can form points of local voltage stress, favourable to electrical breakdown; and that it also encourages formation of water droplets. It has now become known that US-manufactured transformers have also suffered breakdowns, presumably from this cause.

In the gas-cushion technique, a space is left above the oil surface sufficient to permit expansion of the oil. This space is filled with nitrogen from a "top-up" cylinder, the pressure being regulated. There is no air access, so oxidation of hot oil due to its contact with the air of the atmosphere (as can happen when a conservator is used) is avoided.

An important disadvantage of the gas-cushion method arises when it is worked with the nitrogen pressure allowed to vary over a range as large as 2 lb/sq in. to 8 lb/sq in. At the higher pressure, the oil absorbs a volume of nitrogen, which it is slow to give up as pressure falls: it becomes supersaturated with nitrogen. After a time delay, this nitrogen is released as small bubbles, which are liable to give the stress concentrations already mentioned.

Another trouble occurs because, with the sealed gas space, there is, as oil warms up, a transfer of residual moisture from paper insulation to oil, and thence to the gas space. Concentration of moisture vapour there reduces the dew point. Because of this, when ambient temperature falls, water may condense on the tank roof and drip down on to the windings in concentrated droplet form. If such droplets get into the transformer winding, the risk of breakdown is much increased.

Every transformer the English Electric Co. have sold in the US has now been changed to conservator oil preservation with the customer's agreement, in some cases "enthusiastic agreement."

stages of about 1 kV. Connection to l.v. winding or tertiaries permit voltage testing of the largest transformers.

Testing carried out at shop floor level is marshalled from control galleries overlooking the test area. Radio link is used between the various members of the test team to facilitate speedy progress.

Design Trends

Papers presented at the symposium already mentioned fill in the design technique background to the impressive facilities provided by the new works. These must be viewed against predictions of trends in transformer design, the basic consideration of which is that cost per MVA of transformers falls significantly with increase in size, while the associated high voltage and low voltage switchgear, foundations and the necessary land does not change much for a doubling in transformer size.

There are, of course, a number of technical limitations to continued increase in size. There is a general view that individual components of electricity supply systems should not exceed 5% of the aggregate capacity and that the maximum size of a generating unit should not exceed the transmission capacity of the overhead lines. Switchgear design imposes a limit on short-circuit capacity and the current rating of both h.v. and l.v. windings may be limited by that of associated equipment. Overall, there is a limit of about 200 tons for world transport, imposed by bridges, dock cranes and vehicle capacity.

Currently, the increase in flux density is one of the most effective ways in reducing transformer weight. It is common practice now to use as much as 17 kilogauss density for generator transformers and between 15·5 and 16 kG for transmission transformers. Increase in current density can also help reduce weight, but the increased copper loss is uneconomic where load factors are high. The third approach to weight reduction is economy in the weight of structural steel used, which represents about 20% of the transport weight of large transformers. However, although this has led some European manufacturers to use wood liberally there are attendant disadvantages, notably shrinking and production of alkalis in the oil. Aluminium can reduce weight and size—with non-ferrous metals, tanks can fit more closely to windings—but stress requirements make the saving less than comparison of density suggests, there is inherent danger of arc damage, eddy loss is increased. In the opinion of EE Co. designers, aluminium "is a last resort" as a contribution to weight reduction.

Combination of 18 kG flux density, high current density (4,000 amp/sq in.) and a lightweight tank could give a 50% reduction in weight, say less than 200 tons for a 450 MVA, 300 kV generator transformer; but the unit would be uneconomic.

English Electric are investigating as an alternative a subdivision of transformers, three possibilities being:

1. Use of three-phase groups of single-phase transformers.
2. Use of three-phase units with core building and winding assembly undertaken on site.
3. Use of subdivisible three-phase units.

Single-phase transformers cost about 20% more than three-phase units and have an iron loss 30% greater. Building on site is unlikely to be possible because of lack of really effective insulant drying equipment and of the testing plant now required. This makes manufacture of subdivisible three-phase units the best solution. A convenient design for subdivision has a five-limb core, which gives a yoke half the sectional area in that of a three-limb design. The proposed division would be between phases in a vertical plane, involving a break in yokes, tank and tapping leads, assuming three-phase on-load tap changing. So far, this idea has been carried to the developments tests on a one-third scale model and this has shown use of butt joints in such a unit to be free of major problems. The solution looks promising except that it does not solve loading gauge problems.

Windings and Insulation

From the electrical, as distinct from magnetic, aspect, paper, fullerboard and oil remain the major elements in transformer construction. Although paper is the basic material for conductor insulation, the development of larger transformers operating at higher voltages has pointed the need for a new insulating material which combines superior insulating properties with better space factor. A terylene material called Melinex is thought to be promising in this respect. It has a higher breakdown strength than oil-insulated paper (4,000 V/mil at 50 c/s) with an equal dielectric constant and it is impervious to moisture.

It is the impervious nature of the Melinex that makes its application difficult; for oil cannot penetrate it, so there is some risk of air voids and corona formation if it is applied solidly to a conductor. It is being used in combination with paper in a patented way. The conductors are insulated with paper tape, and then Melinex strip in U cross-section is applied alternately upright and upside-down on adjacent conductors. The open end permits penetration of oil into the paper, but a good thickness of inter-conductor insulation is provided.

EE Co. use solid fullerboard for transformers above 110 kV, the major advantage claimed being smaller radial clearances, only about half that for the conventional fullerboard barrier system. Solid fullerboard is also stronger mechanically. To give reinforcement where axial and radial stresses interact along the surface of the fullerboard, each interleaved h.v. disc coil is individually wrapped with additional layers of paper, in a manner that permits access for oil.

Impulse strength considerations with h.v. windings point the need for some form of interleaving. The technique used by the EE Co. is to have pairs of discs alternately carrying conductors from the two coils concerned. Only two interconnections are required, and the mechanical strength of the disc coil is obtained, together with increased series capacitance that can improve impulse performance.

Cores

Increased flux density in transformer cores has already been mentioned. Other changes concern methods of holding together the core laminations. As an alternative to clamping with through bolts, use is being made of two techniques exploiting plastics materials. In one, a close-fitting tube of polyester resin glass tape is fitted over the core and subsequently cured in position to hold the laminations. In the other, a direct epoxy resin bond is made between individual laminations.

Directional properties of cold-rolled 3% silicon steel, so important in reducing iron losses, have a complicating effect at the corners of core stacks. Here, there is a risk of excessive concentration of losses due to flux passing across the direction of the rolling. It is possible to design

Fig. 4. In winding a high voltage disc spiral coil a large number of conductors in parallel are wound simultaneously

corner arrangements that will restrict this effect, but they have to be considered in terms of complexity of cutting.

Noise

Increasing concern about noise is being evidenced by transformer manufacturers. Close attention to this problem is being given experimentally at Stafford. Amongst the techniques used is measurement of vibrations of cores to discover the fundamental origin of the noise. Of course, it is magnetostriction that causes the noise mainly, but quality in this respect varies widely over different consignments of cold-rolled steel that are nominally identical.

Theoretical investigation of the noise problem shows that the oil acts as an excellent coupler to transmit core vibrations to the transformer tank. If the noise transmission is not to be further increased, then the natural vibration frequency of the tank must be kept well removed from the significant components of core vibration. Tank stiffeners require careful consideration from this aspect.

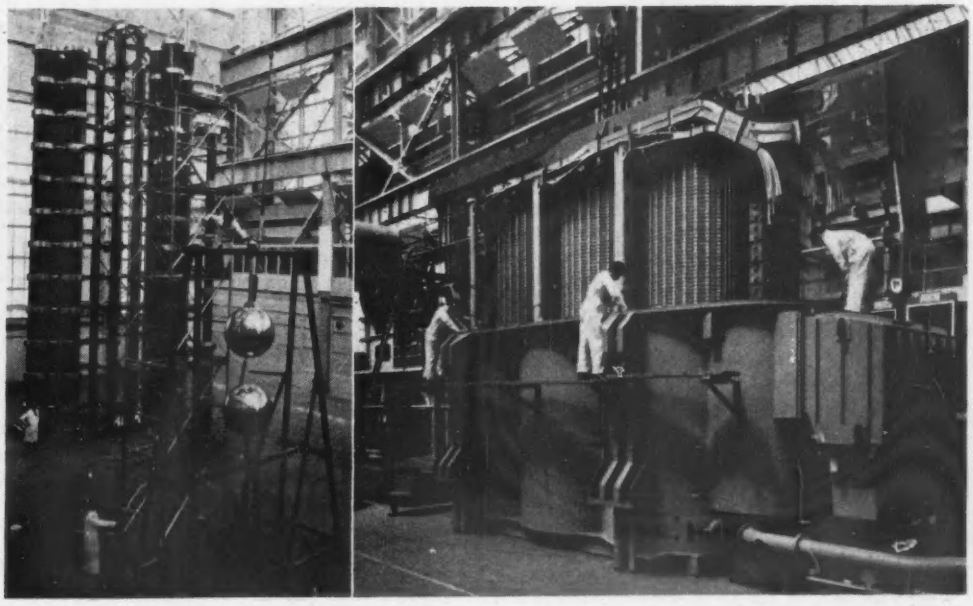


Fig. 2, right. The core and windings of a 210 MVA, 16·2/295 kV transformer being lowered into its tank at the new Stafford transformer works

Fig. 3, left. Equipment associated with the 4·8 MV, 346 kW-sec. impulse generator is being cleaned down before a transformer is tested. This generator has the highest peak voltage of any in Europe

Appliance approval in action

NOV. DEADLINE FOR FIRES, KETTLES, BLANKETS, CLEANERS

SUCH progress has been made with the plan for the approvals board for electrical domestic appliances that this week electrical manufacturers are to be approached to secure their full participation in respect of all their appliances falling within the first group selected for approval. Everything is set for a programmed change-over to full approval for all electrical appliances, although it is not certain when the time will be ripe for a publicity scheme to secure acceptance of the approval mark by the public.

It is less than a year ago that the provisional board of management was set up, and although the Board of Trade has not yet approved the Articles of Association, the organisation planned is a Council of representatives of the industry, the Home Office, National Chamber of Trade, EAW, BSI, and its advisory bodies, under the president, Lord Citrine, together with a board of management, under the chairmanship of Mr T. E. Daniel, with Mr C. A. Zweigbergh as full-time director.

Testing of appliances will normally be carried out at the EDA testing laboratories at Leatherhead, but if necessary other laboratories will be used such as the new BSI centre at Hemel Hempstead. All testing will be carried out to British Standards and the BSI have undertaken that all domestic appliances will be covered by appropriate specifications concerned with safety.

The main purpose of approval will be confined to protecting the consumer and it is felt that in the long run this will benefit all sections of the trade. The tests for approval will not only assess the electrical and mechanical safety features but also the reliability of such features. The testing will be performed on an initial sample or samples and from the resulting test report the committee responsible may authorise the manufacturer to use the approvals mark. However, reliance will not be placed on this initial test alone. It is planned to carry out check testing of approved models at suitable intervals but at not less than once a year. In addition, it is visualised that it may be necessary to visit the factory so that the organisation and conditions of quality control can be assessed as to their effect on the stable standard of production.

Final Approval in February

In the launching of this scheme two factors had to be kept in mind. There had obviously to be an interval of time between the setting up of approval facilities and the full impact of the scheme on the public, in order to ensure the flow of approved appliances through the trade. Also, it was necessary to prevent an excessive rate of application during the initial period so as to prevent testing facilities being swamped. For this reason, appliances have been arranged in groups convenient for laboratory loading. The first group chosen includes radiant fires, electric kettles, electric blankets and vacuum cleaners. Application forms, together with details of the regulations, are now available from the director of the British Electrical Approvals Board, 26-27 Cockspur Street, S.W.1. These forms will be needed by overseas manufacturers importing domestic electrical appliances into the UK if they wish to secure approval by the new Board.

Timing of the first group programme has been fixed and application forms should be submitted not later than 30 November. It is stated that samples will be called forward as required and notification of approval given on 28 February, 1961. The initial work of approval will be eased by the arrangement of accepting, without further test, any appliance appearing in the current EDA list of approved appliances, and electric blankets that carry the BSI Kite mark will be automatically eligible.

The programme for the second group of appliances will not be finalised until after the initial applications of the first group have been received but it is expected that this will be arranged to overlap the first group; a timing early in the new year is, therefore, indicated. Experience will dictate the programming of other groups. The actual design of approval mark is expected to be agreed shortly and is one which must become the symbol of electrical safety.

GAS BOARD REPORT

FOR the second year running the gas industry records a deficit on the year's working, and most of the statistics in the annual report show a decline on the previous year. The bright spot was the 6·4% increase in gas sales to industrial consumers which reflects the increase in industrial activity and the growing use of gas as a fuel. Commercial sales were down 3·5% and domestic consumption by 7·2%; the number of domestic consumers fell and so did the production of coke. Under the stimulus of easier credit conditions, sales of appliances increased. The actual figures are shown in the accompanying table, compared with sales of electrical appliances by area boards, which of course is only part of the electrical sales story as it excludes electrical retailers.

Appliance sales by Gas and Electricity Boards

	Gas Sales 59/60	% Increase on last year	Electric Sales 59/60	% Increase on last year
Cookers	795,578	+19·3	345,923	+ 21·1
Water Heaters ...	232,956	+17·8	259,005	+ 22·3
Wash Boilers ... }	182,755	−20·8	65,398	− 16·1
Washing Machines }			161,998	+ 28·2
Refrigerators	88,350	+76·5	172,537	+109·2

Success is reported with new designs of low price refrigerators and the use of thermostatic control on instantaneous water heaters. A special cooker for physically handicapped people was introduced during the year. Novel methods of flueing water heaters, space heaters and drying cabinets have been introduced for multi-storey flats, and the thirteen schemes in operation are fully instrumented for record purposes. Some 2,000 dwellings using such methods of heating are in course of erection.

I.E.E. local centres

CHAIRMEN'S ADDRESSES DEAL WITH TELEPHONY AND SUPPLY DEVELOPMENT IN MANCHESTER AND NORTH SCOTLAND

RECENT developments in telephone instruments and in the exchange and line equipment were outlined in the address to the East Midlands Centre of the IEE, given by Lt-Col W. E. Gill, T.D., M.I.E.E. (Lt-Col Gill is Telephone Manager of the GPO, Peterborough Area.)

Although the telephone instrument had changed considerably with the advent of a "new look" and use of new materials, notably printed circuits and gravity switches, he said the only major addition was an automatic regulator, while the principal change in design was replacement of the conventional magnetic diaphragm by the rocking armature receiver.

The automatic regulator, now incorporated in new instruments, superseded the barretter device previously located at exchanges which compensated for the considerable changes in line resistance experienced on calls over different distances. The variety of calls handled by modern instruments exceeded the range of the barretter device and it has been replaced by a regulator consisting of a variable loss network made up of rectifier elements and designed to prevent excessive loudness on short lines. Frequency range of the new instruments remained in the band 300 to 3,400 c/s, which gave intelligible conversation without undue cost; however, the instruments achieved a flatter response with consequent reduction in distortion. The rocking armature receiver was largely responsible for the great increase in sensitivity obtained.

Development of new subscriber requirements in unexpected areas could only be met in the past by providing an excess of cable pairs. Lt-Col Gill outlined the "Cabinet-Pillar-d.p. flexibility scheme" which has eased this particular problem considerably by permitting diversion of cable pairs between terminal points. In the cabinet, a cross-connecting frame has, on one side, terminations for the main exchange cable pairs; and, on the other side, cables radiating to a number of pillars. Cross-connection in the cabinet permits selected exchange pairs to be put through to these pillars. Similar cross-connecting arrangements in the pillars permit any pair from the cabinet to be connected to cables linking to a number of d.p's. The system gives economy in the number of exchange pairs—the most expensive item—and enables diversions to be made in the cabinets or pillars more quickly and cheaply than was possible in cable joints.

Cables and Trunk Dialling

Replacement of copper by aluminium conductors for telephone circuits was, he thought, unlikely, but plastics for cable sheathing was rapidly gaining ground over lead because it was lighter, tougher and cheaper. Plastics cables could also be laid without the relatively expensive earthenware ducts which were necessary to protect the lead-covered cable. All local cables up to 100 pairs were now of the all-polythene type and the range would undoubtedly be extended. Their main disadvantage was jointing.

It seemed likely, said Lt-Col Gill, that the first electronic exchange would be installed in London within the next two years. Already, exhaustive tests had been carried out on the experimental exchange at Dollis Hill, which had access to the London network.

The modern telephone system, by using carrier current working and improved designs of amplifiers, had permitted great reductions in cable weight. The latest coaxial system under construction could cater for nearly 2,000 speech circuits using only two coaxial pairs of $\frac{1}{8}$ in. dia and with a three-mile spacing for repeaters.

Supply in the Manchester Area

Meeting the growing electricity requirements of nearly half a million consumers and creating a new single supply organisation from seven separate undertakings was how Mr F. Linley, M.I.E.E., A.M.C.T., chairman of the North West Centre, summarised the work of the past 12 years in the Manchester area when he concluded his address, "Achieving Our Purpose." (Mr Linley is manager of the NWEB Manchester sub-area.)

Outlining the history of the sub-area since 1948, Mr Linley described some of the problems which had to be overcome in the seven sub-areas, which include greater Manchester. This sub-area, although having an area of only 120 sq miles, had a population of $1\frac{1}{4}$ million and by far the greatest concentration of commerce and industry in the country.

Originally, to maintain the personal touch, districts were limited to about 60,000 consumers. Subsequent experience had shown that 80,000 consumers and their associated system could be handled satisfactorily as a district and this led to merging of two of the smaller districts.

The character of the different undertakings in 1948 gave rise to serious load-sharing difficulties and instability, since the network operated both as a transmission and distribution system.

For example, 340 MVA or 84% of the total load comprising Eccles, Sale, Stretford, Manchester and Cheadle undertakings was carried on a solidly connected, 33 kV system, fed by only three power stations of any size and with only a single grid connection at Barton.

Three steps taken by the sub-area to improve supplies were outlined by Mr Linley. In the first stage Carrington power station was commissioned, two further grid intake points were introduced and certain loads transferred.

Three further grid intakes, including one in the centre of the city, comprised the second step. During this stage, outdated switchgear at Barton was replaced and the 33 kV feeder protection system modernised.

Work continues on the third step, aimed at meeting a compound load growth of nearly 6% p.a., which has resulted in a rise from 400 MVA to over 700 MVA and which may well increase to 1,100 MVA by 1968.

In this stage, a further four grid intake points will be required and also 275 kV intakes at Carrington and Stalybridge. Further load transfers will also be made.

A striking indication of improvement in reliability was quoted by Mr Linley for the Altrincham system, which originally operated at 2 kV. In 1948, 36,000 consumer-hours were lost by faults. This was reduced to 120 consumer-hours in the first eight months of this year, despite a load increase from 13 MVA to 30 MVA. This achievement was largely as a result of a £500,000 scheme for the 11 kV and lower voltage distribution systems.

Much of the ex-Manchester 6·6 kV system has been uprated to 11 kV and, although this decision has paid, it was accompanied by, as Mr Linley put it, a disturbing number of faults, mainly on cable terminating lengths and end boxes.

Load growth is expected to require construction of nearly 2,000 substations by 1968, representing a commissioning rate of one every three working days. Difficulties of obtaining suitable sites meant increasing use of transformer units in underground chambers or buried in footpaths.

Development of standard techniques for construction and operation work was given early consideration and it was decided not to wait for area board or national standards to be established. Although some changes have been necessary, this decision has proved justified. An example was safety regulations, which were drafted and in use in a few weeks. Safety requirements were found to conflict with the breaking capacity and operation of many existing switchgear installations and a programme for replacing this gear by units of 150 MVA and 250 MVA rating at a cost of nearly £200,000 is now two-thirds completed.

A vital decision, taken early, was to centralise control at the existing control room in Dickinson Street. This control room now has facilities for control and alarms in 4-132 kV substations, 34-33 kV substations and 117-11/6·6 kV substations and co-ordinates switching of 1,350 network stations.

An early introduction essential to the success of a centralised control scheme was standardisation of all diagrams and methods of operation. The control room now has a complete system diagram and shows all earthed equipment and plant abnormalities. Communication with local substations is maintained through 11 automatic exchanges and about 1,200 telephones. A radio transmitter has also been installed at Stretford, covering the whole sub-area, and 32 vehicles have two-way radio telephones.

Mr Linley concluded by examining the use made of the efforts. He said that only 7% of the total load was on for 100% of the day, whereas the final 25% was only on for about 3% of the day. Such inefficient use of the available resources, he thought, indicate the urgent need for fuel cells or energy storage to meet peak demands.

Supply in North of Scotland

Supply developments also formed the subject of the Scottish chairman's address, given this year by Mr R. B. Anderson, M.I.MECH.E., M.I.E.E. (Mr Anderson is Dundee district manager of the NSHEB.)

He traced the history of supply undertakings from the first plant established in 1890 to the present-day work of the NSHEB. This first installation was built by the monks of Fort Augustus Abbey only eight years after the first experimental station was brought into service in London.

The NSHEB was established in 1943 under the chairmanship of Lord Airlie. Within 18 months, hydro-electric construction schemes were published amounting to nearly 137 MW, including the 130·5 MW Loch Sloy station. Before the Electricity Act was passed in 1947, the Board had ordered 488 MW of hydro-plant and two stations, at Morar and Lochalsh, had been commissioned.

As a result of the Act, the NSHEB took over 16 undertakings totalling 230 MW installed capacity. They became responsible for generation, transmission and distribution in a sparsely populated area in which about half the population of nearly 1·2 million were without supply, and several d.c. to a.c. conversion schemes were required. In the 16 years since their formation to 1959, total capital expenditure by the Board amounted to £205 million and the addition of nearly 196,000 new consumers had nearly doubled the number connected. Mr Anderson drew attention to the rise in cost of connection by comparing the 1948 figure of £100 with the 1958 figure of £270 per consumer.

Hydro generation investment amounted to over £141 million, spread over 38 schemes totalling 785 MW, and with an estimated annual output of 2,148 million units. Two-thirds of this total was consumed in the Board's area, and the remainder, sold in bulk, assisted in paying for supplies to rural areas.

Mr Anderson referred to the NSHEB practice of using a carrier system on power lines for protection, control and communication. Facilities exist on the entire 132 kV network. The carrier system was used for high-speed protection and remote control of unattended hydro-stations.

The Board had experimented with a gas turbine installation at Dundee, a peat-burning, open-cycle installation and a 100 kW wind generator, but none of these schemes seemed to be economically justifiable at present.

In conclusion, Mr Anderson referred to the 400 MW pumped storage scheme now under construction at Loch Awe. This scheme is anticipated to give a cost per kW of only £38 and the annual charges per kW are expected to be considerably lower than other types of generating plant.

Nearly 90% of all possible consumers are supplied and present schemes aim at supplying a further 5,000.

Fig. 1. Manchester control room at Dickinson Street. The centre has a wall diagram of the complete system and has facilities for control and alarms at 155 substations and 1,350 network switching stations

NOTES ON WIRING

BY MEGOHM

NOW that the time has arrived for us to seek the company of the fire in the evenings, some of us will be looking more closely at the decorations in the home, and either congratulating ourselves on having done them or visualising the task ahead of us. Whichever category one falls into I feel sure that at some time he, or she, must have looked at the switch and socket positions and vowed that something would have to be done about the business of "feeling" for a switch in the darkness, and its subsequent grubby evidence. I was in such a mood only the other day, and my aching limbs kept reminding me of the fact that unless something was done then my entire effort might be spoiled.

I still had the problem on my mind when the answer was placed in front of me. The answer was in the shape of a perspex "collar" of the size to fit around and behind the cover plate of a flush switch of the type mounted in BS 1299 or 1363 boxes. It is called a luminous locator and, in my opinion, is an excellent way of finding a switch in the house, for it emits, in the darkness, a bright green electroluminescent glow all round the accessory. In daylight it is an ivory colour and extremely pleasant to look at. Two connecting leads are fitted to the "luminator" and resistors are incorporated in the unit.

I am privileged by being one of the few people to have one of these installed in my house, and it has aroused great interest and admiration amongst friends. I have sited it in my porch, where previously people did have difficulty in finding the switch.

Of course, the house is not the only place where I can see this most useful accessory being used. I recently mentioned the homes for elderly and infirm people and I foresee great use being made of it in such places. The price (5s 8d) is surely as reasonable a one as anyone can ask for. Some accidents in the home could be prevented by this accessory.

Cartridge Fuses

Many homes are now equipped with consumers units which use cartridge fuses. My own house is, and on doing my normal check of spare fuses, etc., before the winter really sets in I discovered that there were no 30 A ratings in my stock. Next morning I walked into my local electricity showroom and requested: "Two 30 A cartridge fuses," and was rather surprised to learn that, besides not stocking them, the gentleman serving me did not know where they were used in the normal household. I explained that I had two such fuses in my consumer unit at the meter position but it still failed to register. I explained that you could either have rewireable or cartridge fuses in such a unit, and I left the shop almost feeling that it might be me that was wrong after all.

I then made my way along to two electrical shops and got the same answer but with a slight difference. Both shopkeepers informed me that they only stocked a few cartridge type fuses of the lower rating as they found that most householders regarded the local electricity showrooms as the "correct" place to purchase such things. I must say that the two shopkeepers knew what a 30 A cartridge fuse was and why I wanted one. It seems to be a sad state of affairs when this happens. No wonder there is the resort to such things as tinfoil and pieces of hairpin that we hear about to keep apparatus going!

Indicator Lights

I had an interesting chat with a resident engineer the other day on the matter of indicating lights and was pleasantly surprised to be shown some of his ideas on the matter. Perhaps he had carried his ideas a little too far, for he had near indicators on all his main switches and all his isolators, etc. On his t. p. and n. switches he had three indicators with different coloured glasses. I admit that the installation was very old and tnat he had had a lot of trouble with fuses and so on due to badly trained operators on the machines. This was his way of trying to do something about it all and, at the very least, it helped him to find the spot affected quite quickly.

I wonder just how many plants are in a similar bad condition through bad maintenance and lack of money being diverted to the engineering works? Machines are in some people's minds something which *should* work for years and years without trouble. Similarly, electrical installations are thought to be ageless. I have often expressed my opinions on the possibilities of providing a reasonable inspection and test of installations, but I cannot see any move in the industry to provide such facilities.

Site Conditions

My recent remarks on alleged conditions prevailing on building sites, when little or no care was given to the electrical conduits, etc., by the builder, have attracted evidence suggesting that these are not so isolated as I had hoped. Letters from my readers comment not only on the attitude towards the electrical installation but to many other things. One contractor told me this week that he had laid m.i.c.c. cable in a floor screed having first ascertained that cork tiles were to be *stuck* down on the finished floor. The work was done with the full approval of the architect and my friend was startled to learn a few days later that faults had developed in the wiring system. Investigation showed that although the cork tiles had been stuck down they had also been "pinned" at certain places by means of nails similar to the old-fashioned gramophone needles. The m.i.c.c. cables were pierced in places by these needles.

Much of this sort of trouble appears to be the result of "sub-contracting" certain works by the builder. Many builders, of the smaller size especially, employ only labourers and perhaps one carpenter and one bricklayer. When such a builder gets a job to quote for, he obtains other quotes for the plastering and plumbing, etc., and it is quite obvious that these sub-contractors do not wish to waste any time on the job or be held up by, for instance, the electrician altering a conduit or something of that nature. Plasterers are well known for such attitudes for I have seen many instances of boxes being 2 in. behind the face of the wall and elsewhere on the same wall a box protruding ½ in. beyond the finished wall. These are the things which get the building industry a bad name and we in the electrical trade cannot afford to share it.

OVERSEAS NEWS

from our correspondents abroad

CANADA

Another Station

The Red Rock Falls generating station of the Hydro-Electric Power Commission of Ontario entered its final phase recently when the last diversion portgate was closed and the river started backing up behind the dam. Expected to be in operation late next month, the 38 MW development on the Missisagi River is, in fact, the smallest of the 13 hydro-electric plants built by the Commission since the war.

Direct Sales Hit Retailers

Direct sales of electrical appliances by manufacturers to apartment builders and developers, coupled with a general falling off in the appliance market is causing concern to Canadian retailers. The practice of manufacturers supplying builders direct originated 25 years ago but has only been adopted by Canadian manufacturers in the last two years to encourage sales. Retailers complain that apartment builders are obtaining refrigerators and other domestic appliances sometimes at less than the wholesale price to the retailer, and that some of these are "leaking" to the general public. Mr Jack Blustein, of New Era Home Appliances says that if the situation does not improve many retailers will be put out of business. Mr S. J. Randall, president and managing director of General Steel Wares, who make washing machines and other domestic electrical equipment, is reported to have conceded that his company offer special rates to builders. But in a period of shrinking sales, manufacturers can't expect to stay in business when other manufacturers, many of them subsidiaries of US companies where the practice is widespread, offer builders reduced rates. Mr Blustein argues that if the manufacturer sells his products at cost or less than cost to apartment builders, he must increase his price to the regular retailer and, therefore, the ordinary citizen is actually subsidising apartment builders.

Columbia Power Controversy

Formation of an international power pool to make full use of Canadian hydro-electric potential was urged by Mr J. D. Stevens, consultant for the Peace River scheme, and Mr R. D. Chantrill, AEI Ltd. They were speaking at the forty-fourth annual conference of the Pacific North-West Trade Association.

Criticism of the proposed 50-50 basis for sharing downstream benefits of the Columbia River scheme, between Canada and the US, were made by Dr John Davis, director of research and planning for the BC Electric. He maintained that the combination of Canada supplying more than ten times the capital provided by the US, and the higher rates of interest prevailing in Canada could well mean that Canadians would pay up to 20 times more than Americans for their electricity. He also urged the proposed order of construction should be changed, that the Arrow Lake and Mica Creek schemes should be combined and that these should be followed by Libby dam.

Nuclear Association Formed

A central agency to stimulate development of nuclear energy for peaceful purposes, the Canadian Nuclear Association, has recently been formed to correlate the requirements of industry, utilities and educational institutions in nuclear development.

President of the association is Ian F. McRae, chairman of the Canadian General Electric Co., and the vice-president is the Ontario Energy Resources Minister, Mr R. W. Macaulay. Objectives of the CNA are to promote healthy growth and use of nuclear energy and radio isotopes and to encourage co-operation between all authoritative bodies by providing a forum for discussion of problems concerning members of the industry or public.

The association will study technical problems, professional and technical manpower requirements, legislation and insurance problems and education, and will produce publications on home and overseas developments and opportunities.

WEST INDIES

Assisted Wiring

An assisted wiring scheme is being introduced by the Trinidad and Tobago Electricity Commission under a Bill passed by the Legislative Council at its last session. This empowers the Commission to wire homes and recover the cost over three to five years. The scheme is intended primarily to bring electricity to owners of smaller property. Consultations have been held between the Electrical Retailers' Association and wiring contractors to produce schemes whereby groups of houses, of about 60 or more, can be wired as one project, thereby reducing the cost. As a start, it is proposed to undertake four trial projects, two in North and two in South Trinidad.

U.S.S.R.

Exploiting Solar Energy

Developments in the use of solar energy were discussed at a recent conference held in Tashkent, the capital of Uzbekistan, a Soviet republic containing two of Central Asia's biggest deserts. A solar thermal station has been developed with a capacity of 2·5 MW, able to irrigate up to 12,500 acres and to distil drinking water for the entire population of an oasis. The conference discussed methods devised by Soviet technicians for establishing "solar oases" in the desert, utilising the power of the sun.

SCANDINAVIA

Budget Benefits Industry

The Norwegian budget for 1961, recently presented to Parliament by Finance Minister Petter Jakob Bjerve, provided for various telecommunication and hydro-electric schemes. £2·5 million has been allocated for hydro-electric schemes which will absorb a total capital investment of £13 million, of which the Tokke scheme will absorb nearly £6 million. It is proposed to spend nearly £3 million on road construction and nearly £2·5 million on telecommunications. Estimated deficit for the State Railways will go down by £2·5 million. Increased grants for the railways are likely to be proposed as a step in their modernisation programme.

Power Exports

A 380 kV power line between Hälsingborg and Hamburg is the main alternative in the current investigations into the possibilities of co-operation in the field of power supply between the Scandinavian countries and Western Germany, according to the Swedish State Power Board. A study committee with five expert groups has been appointed and is expected to present its findings early next year. Norwegian member of this committee is Dr F. Vogt who was until recently director-general of the Water courses and Electricity Board.

NIGERIA

Electrification Progress

A further stage in the programme of electrical development in Western Nigeria provides for supplies to eight

further towns by the end of this year. The five-year electrification plan, which is based on a £1.3 million interest-free loan by the Western Region Government, provides for electrification of 32 towns by the end of 1961.

INDIA

Nuclear Tenders

The Government of India is now seeking global tenders for the nuclear power station which is to be located near Tarapur, about 62 miles north of Bombay. As we reported on 1 Sept., the station is to have two reactors, each of 150 MW. There is likely to be keen competition for this first nuclear power plant for India.

PAKISTAN

Multan Power Station Extension

Multan natural gas power station is to be extended by 130 MW. A letter of intent was recently issued by WAPDA to four West German firms for the supply and installation of the equipment for which 85% of the foreign exchange cost will be met by a loan from West German banks. The extensions will comprise two, 65 MW turbo-alternators with natural gas-fired boilers and they are to be completed within 35 months.

Bank Loan to WAPDA

A loan by three leading Pakistani banks to WAPDA of Rs5 crore will assist WAPDA to finance power projects which include the Quetta thermal station and Rawal hydro-electric project. WAPDA is issuing debentures worth Rs5 crore to cover these schemes and a further Rs11 crore will be utilised for extending the Multan natural gas power station.

Expanding Production

If a recently announced plan is fully implemented, production of the electrical goods in Pakistan is likely to increase by 150% in the next five years. The plan expects that more than Rs6 crore will be spent on the improvement and expansion of the electrical goods industries. At present, Pakistan imports Rs2 crore 7 lakh worth of electrical goods every year and, out of this total, Rs2 crore are spent on importing appliances and new goods and Rs70 lakhs on spare parts.

AUSTRALIA

Supply Change Reduces Cost

From 1 Sept. electricity supply in Collinsville and Scottville is the responsibility of Townsville, Queensland, Regional Electricity Board. The Regional Board has taken over the existing undertaking operated by the Shire of Bowen. Substantial reductions in the electricity charges are made possible by the change.

Line Extension

A power extension scheme, estimated to cost £375,000, is proposed by the North West County Council. The extension, covering some 375 miles, will serve rural areas of New South Wales and Southern Queensland, including the towns of Boomi, Talwood and Bungunya. If prospective consumers approve, work is expected to begin next month and the whole northern border extension should be completed by the end of 1963.

Aluminium Plant Deal

The Commonwealth Government decision to sell its share in the Bell Bay aluminium plant to Consolidated Zinc for £11 million was recently announced by the Premier, Mr Reece. Under the agreement, which was the result of two years' protracted negotiation, the Tasmanian Government will retain a one-third interest in the plant. Future of the plant is not only ensured but expansion is planned from the present output of 12,000 tons of aluminium to 28,000 tons and later to 40,000 or 50,000 tons.

The existing plant takes 35 MW from the State Hydro-Electric Commission and increased power for the expansion programme will be met under the Commission's development programme which was drafted several years ago. Supply to the plant will be augmented by power from the Poatina scheme when it comes into operation in 1964.

Tully Hydro Scheme Progress

A further stage in the Tully hydro-electric scheme for bringing power to North Queensland was completed recently when the Premier, Mr Nicklin, inaugurated the Koombooloomba Dam. Three regions served by the Cairns, Townsville and Mackay Regional Electricity Boards will benefit from the project which is estimated to have cost them so far £40·5 million. Work on the dam began in August, 1956, and, owing to urgent power demands, the completion date was advanced from 1962 to 1960.

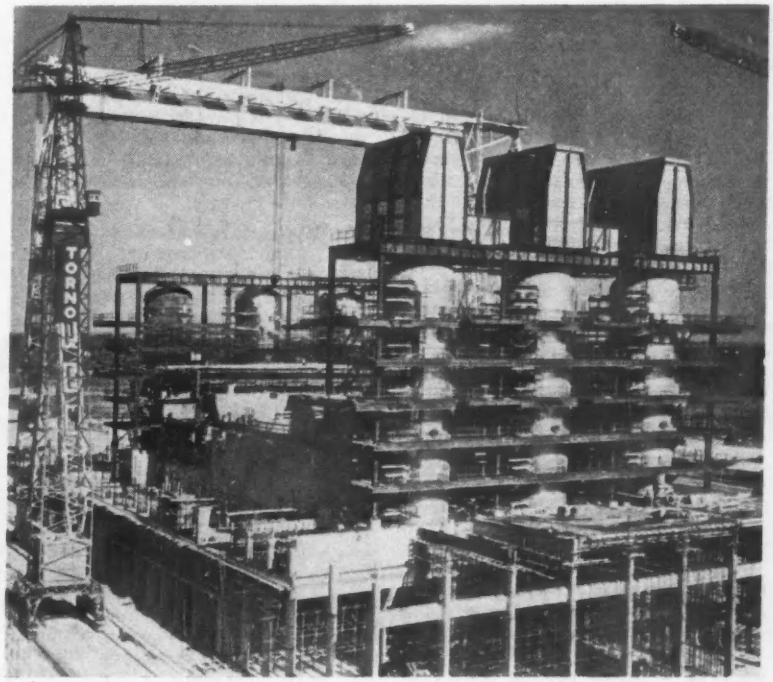
Debenture Stock Conversion

The Electricity Trust of Southern Australia is to offer early conversion of publicly held £5,558,870 of 4¼% debenture stocks. These debentures, which mature on 1 June, 1962, can now be converted to new debentures with an eight-year term.

THAILAND

H.E. Experts

Recently a group of Australian scientists and technicians left Australia to begin development work on the Mekong River scheme. This scheme will provide power for Thailand, Laos, Cambodia and Vietnam. In addition to providing hydro-electric power, the scheme plans for irrigation and flood control of South-East Asian countries with a population of 17 million.



Progress on construction of Italy's Latina nuclear power station is indicated in our accompanying photograph, where the six heat exchangers are now seen in position. The design for these vessels was supplied by Head, Wrightson and Co. Ltd., and they were manufactured in Italy by Nuovo Pignone. The Latina power station is being built by the Nuclear Power Group

Personalities *in the industry*

Newly elected president of the Purchasing Officers' Association for 1960-61 is **Mr W. H. Parry,** who joined the Charles Colston group two years ago as purchasing manager. He was later appointed commercial manager and vice-chairman of the group Purchasing Committee. This year he became general manager of the High Wycombe Division. Before joining Colston Mr Parry was chief purchasing agent of Simplex Electric Ltd.

Atlas Lighting Ltd. announce the appointment of **Mr R. A. Barrington** as area manager for the London North sales area, operating from 105 Judd St, W.C.1. He joined Thorns in 1950 as sales representative for the Central London postal district.

Mr C. H. Sparks, formerly a director of Babcock and Wilcox, has been appointed in an advisory capacity to the board of Hawker Siddeley Brush Turbines.

Mr W. L. Henderson has been promoted to manager of the London works of Dowding and Mills Ltd., with **Mr P. A. Chambers** as assistant. At the firm's Birmingham works **Mr H. Westwood** becomes manager, with **Mr F. J. Gardiner** as assistant.

Mr J. G. Christopher, director and general sales manager of Atlas Lighting Ltd., left England last week-end on a visit to South Africa. His itinerary includes calls at Johannesburg, Cape Town, Port Elizabeth and Durban and, before returning to England on 8 Nov., he will visit Thorn's associate company, Ilesia, in Vicenza, Italy.

The Leon Gaster Memorial Premium of the Illuminating Engineering Society for 1960 has been awarded to **Mr H. C. Weston,** O.B.E., F.I.E.S., for his paper "Rationally Recommended Illumination Levels," which was presented at the IES summer meeting at Harrogate in May. Mr Weston was until recently with the Medical Research Council. He was responsible for much of the fundamental work carried out in this country on the basis for recommended illumination levels which has been incorporated in successive editions of the IES code. Mr Weston is now a consultant to Atlas Lighting Ltd.

Formerly area manager in the London district of Charles Colston's Electrical Appliance Division, **Mr K. R. T. Brown** has been promoted to district manager. The company also announce three appointments in the Midland branch: **Mr H. Griffiths** moves from South Wales to become manager of the East Midland district; **Mr C. J. Wilkins** becomes district dealer liaison manager in the south western district; and **Mr R. Rowntree** takes up a similar post in the South Wales district. In addition, **Mr M. Lindsay** has been appointed an area manager in the South Scottish district, and **Mr W. Wilson,** district dealer liaison manager of the North Scottish district.

Mr T. H. Thorneycroft, M.A., a director of the Harland Engineering Co. Ltd., has been elected to succeed the late Mr H. Cowan-Douglas as chairman of the company. Mr Thorneycroft, who is also executive director of Wm. Baird and Co. Ltd., Glasgow, was deputy chairman of the Scottish Division of the National Coal Board from 1947 to 1949.

British United Traction Ltd. announce that **Mr Ronald Ellis,** B.SC.TECH.(HONS.), A.M.I.MECH.E., M.I.LOCO.E., ASSOC.INST.T., relinquished his executive duties as general manager of the company on 15 Oct. Mr Ellis will, however, be appointed to the board of directors in order that his advice and guidance in the field of rail traction and trolley-buses will be continuously available to the firm. **Mr F. G. Headen,** the present secretary of the company, will take over Mr Ellis's executive duties as manager. **Mr J. D. Slater,** A.C.A., has also been nominated to the B.U.T. board of directors.

Mr W. T. Flower has been appointed deputy managing director of Bailey Meters and Controls Ltd., a subsidiary of Babcock and Wilcox Ltd.

General sales manager with Clarke, Chapman and Co. Ltd. for several years, **Mr W. Hanlon** has been elected to the board of directors. He joined the firm over 30 years ago.

Deputy station superintendent at Ipswich generating station, **Mr C. W. Tricker** was last week the recipient of a presentation from **Mr W. N. C. Clinch,** controller, Eastern Division, CEGB, on his completion of 50 years' service in the industry.

Mr Harry Copping, M.I.E.E., M.A.I.E., M.E.I.C., P.ENG., president and managing director of ECC Canada Ltd., has arrived in England on a visit to the parent companies: Electric Construction Co. and George Ellison Ltd. He will also visit Tufnol Ltd.

Mr G. Orloff, M.I.MECH.E., A.F.R.AE.S., has joined the Industrial Division of the Sperry Gyroscope Co. Ltd. as a consultant.

London Transport announces that **Mr J. I. McGillivray,** B.SC., A.R.I.C.S., A.A.I., has been appointed estate agent and rating surveyor, becoming an officer of the executive, with effect from 3 Oct. He succeeds **Mr T. C. West,** who has retired.

Crompton Parkinson Ltd. announce the following appointments to the boards of its subsidiary manufacturing companies. **Mr A. S. Duncan,** B.SC., general manager of the Newport works, has been elected to the board of the Young Accumulator Co. Ltd.; **Mr A. E. Gregg,** general manager of the Chelmsford works, has been appointed to the board of Crompton Parkinson (Chelmsford) Ltd.; and **Messrs J. C. Mansfield,** B.A., and **D. Ebben** who are assistant general managers, respectively for motor production and lamp production at the Guiseley works, having joined the board of F. and A. Parkinson Ltd. In addition, **Mr K. Younger,** general sales manager of the Crompton Parkinson Ltd. Heavy Plant and Transmission Division, has been appointed to the boards of Crompton Parkinson (Chelmsford) Ltd., British Electric Transformer Co. Ltd., and Cooke and Ferguson Ltd. **Mr C. J. W. Scott,** general sales manager of Crompton Parkinson Ltd., Industrial Motors and Lighting Division, has been appointed to the boards of F. and A. Parkinson Ltd. and Crompton Parkinson (Doncaster) Ltd.

Mr S. F. Newey, B.SC.(ENG.), A.M.I.MECH.E., A.M.I.E.E., has been appointed project engineer of the Midlands Project Group of the CEGB. (*ESH, page 52.) Since 1959 he has been an assistant project engineer with that Group. After serving an apprenticeship with the Brush Electrical Engineering Co., of Loughborough, Mr Newey graduated at Birmingham University,

Mr W. H. Parry

Mr A. E. Gregg

Mr K. Younger

following which he joined the City of Birmingham Electric Supply Department. In 1950 he became general assistant engineer in the Generation Construction Department of Midlands Division of the then BEA. From 1952 to 1955 Mr Newey was an assistant engineer with the Authority's East Midlands Division, followed by a short period as personal assistant (technical) to the East Midlands Divisional Controller. He then returned to construction work in the Midlands Division, becoming senior mechanical engineer at Wolverhampton in 1957.

Mr M. W. Searle, managing director of Electra (Birmingham 1935) Ltd., was recently presented with a silver rose bowl in celebration of his 25 years with the firm. The rose bowl was subscribed for by the managers and staff of Birmingham, London, Leeds, Eastbourne and Newcastle branches and was presented by Mr A. J. Tanner, general manager, on their behalf.

Mr H. V. Rowlands has been appointed sales director for Burtonwood Engineering Co. Ltd. He joined the company in 1930 and became a member of the board of directors five years ago. In 1954 he was responsible for forming the Plastics Division.

Mr J. H. P. de Villiers, A.H.-W.C., M.I.E.E., has demitted office after seven years as hon. secretary to the Scottish Centre of the IEE. Mr de Villiers, who served on the Centre Committee first as hon. assistant secretary, is succeeded by **Mr D. R. Rollo,** B.SC., A.M.I.E.E.

Mr G. F. Roberts has retired from the position of managing director of the Zenith Electric Co. Ltd., and **Mr W. Bloomfield,** technical director, has also retired from the executive. Both are being invited to retain their seats on the board. The vacancies are being filled by the appointment of **Mr L. W. Laurence** and **Mr J. A. Shorter,** as joint managing directors, and of **Mr L. E. Ward** as technical director.

Joint general manager of the AEI Cable Division, **Mr J. S. A. Bunting,** M.C., has been elected as a companion of the IEE. A member of the Council of the Electrical Research Association for many years, Mr Bunting has been chairman of the MCMA, the RCMA and the CMA itself. At present he is vice-chairman of the Export Association of the cable industry.

Mr H. G. Campbell, managing director of Benjamin Electric Ltd., at a dinner at the Grand Hotel, Birmingham, last Friday presented an engraved gold wrist watch to **Mr D. J. Caddick,** the company's sales engineer for Birmingham and district, as the award of merit for sales engineers of the company for 1959-60.

The chairman of the Federal Power Board of Rhodesia and Nyasaland, **Sir Duncan L. Anderson,** K.B.E., T.D., is to retire in June, 1961, on his 60th birthday, Sir Duncan, who practised as a civil engineer on railway, road, bridge and tunnel construction from 1922 to 1939, has been responsible for the building of the Kariba hydro-electric project. He became chairman of the former Federal Hydro-electric Board in 1955 and of the Federal Power Board when it was formed in the following year. He was knighted in the last New Year's Honours List. **Mr G. R. Peterson,** B.A., M.I.E.E., M.I.MECH.E., was recently appointed general manager of the Federal Power Board to take over as chief executive from Sir Duncan. He had been deputy chief executive from 1957.

Mr W. A. G. Bass, B.SC., A.K.C., M.I.E.E., has resigned from the board of Ferranti.

Mr R. L. C. Todd, of Thorn Electrical Industries Ltd., will leave on 23 Oct. on a two-month business tour of the Far East. He will be calling at Karachi, Lahore, Dacca, Chittagong, Calcutta, Rangoon, Bangkok, Hong Kong, Singapore, Sandakan, Brunei, Kuala Lumpur, Colombo, Bombay, returning via the Middle East.

Formerly representative for Berry's Electric Ltd. in London and the South East, **Mr L. E. Gates** has been appointed sales manager of the firm's Water Heater Division.

Mr F. W. Perks, sales director of British Radio Corporation Ltd. is to retire, and will be succeeded by **Mr T. B. Henderson,** general sales manager of Philco (Gt. Britain) Ltd.

OBITUARY

Mr David Yuille, of Robert Yuille and Sons Ltd., Glasgow, died on 11 Oct.

Mr R. S. Whitfield, who was control engineer at Darlington power station until retiring through ill-health in 1950, has died aged 62.

Mr Eustace Thomas, M.I.E.E., who was a partner in the firm of Bertram Thomas (Engineers) Ltd., died on 11 Oct., aged 91. In 1900 he joined his brother, who had recently started that firm, but earlier was with the BTH Co. and concerned in the early electric tramway developments.

Mr C. K. Woodbridge, chairman of the Dictaphone Co. Ltd., died on 16 Oct., aged 79.

Mr W. J. M'c. Girvan, O.B.E., A.M.I.E.E., formerly city electrical engineer of Belfast, died on 16 Oct. He retired in 1952 after holding that post for ten years. He originally joined that undertaking in 1913, and subsequently filled every technical and administrative position, becoming deputy city electrical engineer in 1935. He was one of three members of the Northern Ireland Joint Electricity Committee and chairman of the N. Ireland JIC and Joint Board for the Electricity Supply Industry.

The Earl of Verulam, COMP. I.E.E., HON. M.I.H.V.E., F.B.I.M., J.P., who died on 13 Oct., aged 50, was due to take office as president of the Association of Supervising Electrical Engineers this month. His passing will be regretted in our industry, in which he had many friends. Lord Verulam was chairman of Enfield Rolling Mills Ltd., Engineering and Lighting Equipment Co. Ltd. and Sternol Ltd. Educated at Eton and Christ Church, Oxford, he was employed in Austrian and German metal concerns from 1932 to 1936 when he formed Enfield Zinc Products Ltd. at Tottenham. He was managing director of Enfield Cables Ltd. from 1943 to 1953, and was Mayor of St. Albans in 1956-57. He was also for some years a part-time member of the North Thames Gas Board, and had been chairman of the British Institute of Management and the Institute of Industrial Administration.

Lord Verulam

BRITISH STANDARDS

Concrete Poles for Electrical Transmission and Traction Systems. *BS 607 : 1960. Price 4s 6d.* This is a complementary specification to BS 1308, "Concrete Street Lighting Columns," for those applications where the torsional and bending loads are significant. Transmission line and overhead traction line supports are the obvious and intentional uses of the specification, but other uses involving similar stresses are also applicable. Originally published in 1935, this is the third revision, the main difference lying in the deletion of the appendix on recommendations for use of the three classes, reinforced, prestressed and prestressed with liability to impact, as transmission line supports, since it has been felt that conditions vary to such an extent, as to make general recommendations a danger in practice. There are some other minor amendments.

Lamp Caps and Lampholders for Double Capped Lamps. *BS 495 : 1960. Price 3s.* The original specification for caps in connection with double-capped tubular filament lamps was first prepared in 1932 and was last revised eight years ago. In this, the third revision, the title has been amended, the contents brought into line with current practice and a paragraph on the requirements for a combined pair of lampholders added.

Copies of these two standards may be obtained from the British Standards Institution, Sales Branch, 2 Park St, London W.1.

* *Denotes revision to the "Electricity Supply Handbook, 1960."*

New Zealand Plans Ahead

NEW ZEALAND supply authorities are likely to spend £5 million on capital account in the current financial year, £1½ million coming out of revenue. Expenditure is likely to continue at about the same level for the succeeding four years, say the official NZ Committee to Review Power Requirements, which reported recently. The Committee, who make an annual review of the forward situation, estimate that by 1965 the North Island will be experiencing a peak load of 1,307 MW, with an annual generation of 6,640 million kWh. Corresponding South Island figures are 562 MW and 2,710 million kWh. In 1970, the corresponding figures are: North Island, 1,780 MW, 9,038 million kWh; South Island, 763 MW, 3,677 million kWh. The Committee warn that the past experience of restrictions on use of electricity have brought a lack of confidence in the North Island, which is affecting the willingness of the public to use electrical techniques. However, the Committee believe that in three years' time the normal pattern of growth will be restored.

Another committee, the Planning Committee of Electric Power Development in New Zealand, has also produced their annual report. This Committee is concerned with the balance between power needs and plans for generating plant installation. At present, plans for the North Island envisage some shortage in energy (as distinct from power) if any year after 1963 is dry in the hydraulic sense. There is also prospect of some shortage in the South Island in 1963 and 1964 in the same circumstances.

Submarine Cable

Some progress is reported concerning the proposed inter-island submarine cable link. Trial lengths of cable which had been laid off the North Island shore for about two years have been recovered and show no signs of damage, although they were placed deliberately in a rocky area. The cables are now being examined in England. The operation of lifting the cables was carried out in a small vessel and some doubts about problems of navigation during cable operation in these waters were removed. Evidence is increasing that the so-called short route is practicable for cable laying between the two islands. The report says: "If the reports on the trial cable and the tidal tests now being conducted prove favourable, the inter-island transmission based on the short route must be considered as one of the means of dealing with future power supplies." There is a warning that decisions about the use of the power at Benmore hydro station must be taken just as soon as essential issues are clarified.

KARIBA IN OPERATION

KARIBA generators have produced and dispatched 378·4m kWh during the first six months of operation at a generating cost of 0·4727d per unit and have contributed £Rh300,000 towards the financing of the second stage. That is the immensely heartening substance of the annual report of the Federal Power Board which was simultaneously presented in London by the chairman, Sir Duncan Anderson, K.C.B., T.D., and in Salisbury, Southern Rhodesia, by Sir Malcolm Barrow, C.B.E., M.P., Minister of Power in the Federal Government, on Monday last, 17 October.

This output corresponds to a saving of 190,000 tons of coal in thermal power stations and compares with the forecast of 0·869d per unit which it was anticipated would be reached in 1961. The Kariba project has, therefore, not only beaten the target date for commencement of supply—estimated as being 1961 in the 1956 estimates—but has also enabled the Board to show lower production costs than had been anticipated. True, the lower figure is to some extent accounted for by differences in the methods of calculation, in that the estimated figures were based on depreciation allowances which are not now considered necessary, but the net profit, with only two generators in operation, of £Rh350,520 enables the sum of £Rh300,000 to be transferred to the capital reserve account for the initial work on the second stage. The figures, of course, are based on the total profits from Kariba and the thermal power stations. The actual figure per unit for the mixed hydro and thermal supplies is 0·5796d, as compared with the original estimate of 0·757d per unit. As the Board has been able to sell the power at an average price of 0·7579d per unit during 1960, practically identical with the original estimate of cost, and has made an average monthly profit of more than £Rh50,000, the future for Kariba looks extremely promising indeed.

Consumption in the areas served by the Board has increased and, in the year ended 30 June, 1960, was 2·16% above the estimates. Revenue from sales of current totals £Rh1·49 million, from which must be deducted £Rh410,000 for power purchased from the thermal undertakings. Load growth has been more rapid than expected at Salisbury and two further transformers have been ordered as extensions to the plant there in anticipation. One transformer for Bulawayo has been cancelled, however, as the demand here is not increasing as rapidly as expected.

Construction Costs

The report discloses some interesting features of the capital expenditure on the construction of the project. Originally estimated to cost £Rh79·414 million, the revised estimate, including additions to cover damage by floods, in 1960 was actually lower at £Rh74·755 million. This figure includes contingency allowances. Most of this saving is due to electrical and mechanical works which are down by £Rh6·7 million. The effect of this will be a reduction in finance charges which will also feel the effect of the early earning capacity of the scheme on the reserve fund. But Stage 1 is still not complete—No. 3 Generator is due for commissioning in the next few weeks and the fourth and fifth next year—and experience has shown what can happen at Kariba.

The Board is optimistic about the future and is already well ahead with its plans for Stage 2. Although no programme of construction has been prepared or finance sought, it is anticipated that work will begin in 1962 with a target date for completion in 1967. Other hydro-electric schemes at Kafue and Nkula Falls are also being studied.

Lecture at the I.E.E.

On Tuesday, 18 October, Sir Duncan Anderson joined with Mr T. A. Lyall Paton, C.M.G., B.SC., M.I.C.E. (Sir Alex. Gibb and Ptrs) and Mr C. L. Blackburn (Merz and McLellan) in presenting a paper on the first stage of development of the Kariba Hydro-electric project. In the paper the problems which arose during construction and the methods of surmounting them were explained.

Series capacitors and stability

TRANSIENT BEHAVIOUR OF DOUBLE-CIRCUIT LINES

by S. P. R. Choudhuri, B.E.E., Dr. Ing.*

SERIES capacitors are being increasingly used on e.h.v. transmission systems as a means of improving system stability. The series capacitor provides capacitive reactance which partially compensates for the inductive reactance of the transmission line and so reduces the power-angle of the system, enabling power transmission under steady-state conditions to be increased.

To prevent damage to series capacitors by transient over-voltages, they are usually shunted by spark-gaps. This article shows how the transient stability of a double-circuit system is affected if, as a result of a fault on one circuit, the series capacitor in the healthy circuit is by-passed. From data obtained on a 400 kV, 600 MVA, 900 km transmission line, calculations have been made to determine the maximum permissible duration of the short-circuit across a series capacitor which will still allow system stability to be maintained. A general expression for the critical angle at which the capacitor must be brought back into service is derived.

List of Symbols

H = Inertia constant of hydro station machines.
$K = X_c/X_l$, degree of series compensation.
P = Power transmitted.
P_i = Initial power transmitted.
P_M = Amplitude of power-angle characteristic under normal operation.
t_i, t_c, t_d = Different times during the swing.
$X'd$ = Transient reactance of generator/phase.
X_t = Reactance of transformer/phase.
X_l = Reactance of uncompensated line/phase.
δ = Power angle.
δ_0 = Initial angle of operation.
δ_1 = Angle at which the faulty line is disconnected; capacitors in healthy line not in service.
δ_c = Critical angle at which healthy line capacitors must come back in service.
δ_f = Maximum angle of swing.

Transfer reactance ratios:

r_1 = normal/fault operation; double-circuit.
r'_2 = normal/after fault; single-circuit and without capacitors.
r_2 = normal/after fault; single-circuit and with capacitors.

Operation Under Fault Conditions

A fault occurring on one circuit of a double-circuit transmission line, particularly a three-phase fault, will result in a high voltage being applied across its series capacitor. Consequently, the capacitor protective spark-gap will break down. Since the double-circuit line is linked at each end, Fig. 1, a voltage sufficient to flashover the spark-gap will also be applied to the healthy line.

The faulty line will be rapidly disconnected by selective operation of protective relays and its spark-gaps will quickly deionise after the arc is quenched. However, the spark-gaps in the healthy line will take longer to deionise because the line remains energised throughout the fault duration. During the arcing period, capacitive compensation for the line is lost and, if the arcing period is prolonged, system stability will be affected. It is, therefore, important to be able to derive the maximum time for which by-passing of the healthy line series capacitor can be permitted.

Curves are plotted for three different fault locations on the line, with power transmitted (initial power) represented as a function of the maximum permissible duration of arcing on the healthy line spark-gaps.

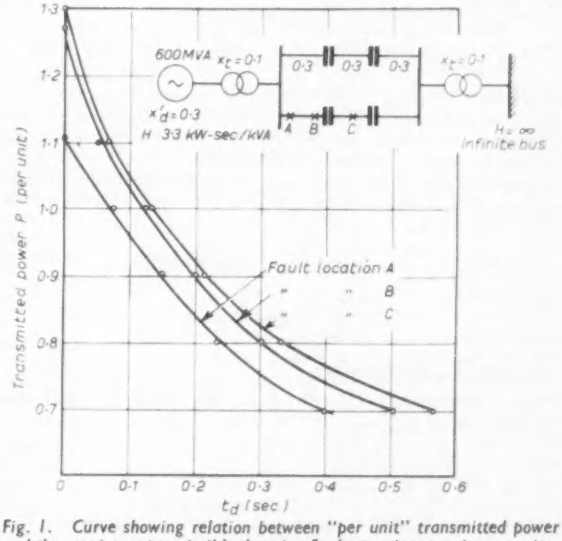


Fig. 1. Curve showing relation between "per unit" transmitted power and the maximum permissible duration for by-passing a series capacitor in a double-circuit line, to ensure system stability

Influence of Transient Stability

The system under investigation is shown in Fig. 1.

The condition to maintain the transient stability is obtained by applying the theory of "Equal Area Criterion" for stability.[2] For this purpose, four transient power-angle characteristics, Fig. 2, have to be used as follows:

1. During normal operation.
2. During the fault.
3. After clearing the fault, but during the interval when the healthy line capacitors are still by-passed by the ignited spark-gaps.
4. When the healthy line capacitors are again in service.

The equations of the four characteristics are, respectively:

$$P = P_M \sin \delta \quad (1)$$
$$P = r_1 P_M \sin \delta \quad (2)$$
$$P = r'_2 P_M \sin \delta \quad (3)$$
$$P = r_2 P_M \sin \delta \quad (4)$$

* Dr S. P. R. Choudhuri is a lecturer at the Indian Institute of Technology, Kharagpur.

Determination of the Critical Angle

The critical angle and maximum duration of capacitor by-passing are obtained as follows:

From the theory of "Equal Area Criterion," the area A_1 (Fig. 2) is equal to the area A_2 to maintain the transient stability. Therefore

$$(\delta_f - \delta_0)\, P_1 = r_1 P_M \int_{\delta_0}^{\delta_1} \sin\delta\, d\delta + r_2' P_M \int_{\delta_1}^{\delta_c} \sin\delta\, d\delta + r_2 P_M \int_{\delta_c}^{\delta_f} \sin\delta\, d\delta$$

or

$$(\delta_f - \delta_0)\sin\delta_0 = r_1(\cos\delta_0 - \cos\delta_1) + r_2'(\cos\delta_1 - \cos\delta_c) + r_2(\cos\delta_c - \cos\delta_f)$$

but $\delta_f = \pi - \sin^{-1}\left(\frac{\sin\delta_0}{r_2}\right)$

therefore

$$\cos\delta_c = \frac{\left[\pi - \delta_0 - \sin^{-1}\left(\frac{\sin\delta_0}{r_2}\right)\right]\sin\delta_0 - r_1\cos\delta_0}{(r_2 - r_2')} - \frac{(r_2' - r_1)\cos\delta_1 - r_2\sqrt{1 - \left(\frac{\sin\delta_0}{r_2}\right)^2}}{r_2 - r_2'} \quad \ldots (5)$$

In the equation (5) for δ_c, δ_0 is determined from the initial conditions and δ_1 is found for a given fault clearing time by "Point-by-Point" method of calculating the differential equation:

$$\frac{d^2\delta}{dt^2} = \frac{\pi f}{H}[P_M \sin\delta_0 - r_1 P_M \sin\delta]$$

for the interval during which the generator rotor moves from δ_0 to δ_1 (fault clearing time t_1). Other quantities in Equation (5) are determined by solving the network for different fault locations; so that the angle δ_c can now be determined.

After clearing the fault, the time t_c corresponding to the angle δ_c is found by "Point-by-Point" method from the solution of the differential equation.

$$\frac{d^2\delta}{dt^2} = \frac{\pi f}{H}[P_M \sin\delta_0 - r_2' P_M \sin\delta]$$

then

$$t_d = (t_c - t_1)$$

System Calculations

Data for a 400 kV, 900 km, 600 MVA transmission system are as follows:

$X'_d = 0{\cdot}3$ p.u.
$X_t = 0{\cdot}1$ p.u.
$X_l = 0{\cdot}9$ p.u.
$K = 0{\cdot}6$
$H = 3{\cdot}3$ kW-sec/kVA
Base power = 600 MVA
Base voltage = 400 kV

The calculations are for a fault clearing time (t_1) of 0·1 sec and for the fault locations A, B and C in Fig. 1.

The curves of transient power stability limit, P, as a function of the maximum permissible duration of capacitor by-passing (t_d) are also shown in Fig. 1.

Conclusions

The curves, Fig. 1, show the maximum permissible duration of series capacitor by-passing in the healthy line as a function of the power transmitted. These curves can be used for designing suitable spark-gaps to give the permissible quenching times for given values of power transmitted while maintaining transient stability of the system.

The effect of decreasing the quenching time can be seen in the curve for fault location A. If the by-passing duration of the capacitors is reduced from 0·39 sec to 0·075 sec, the transmitted power can be increased from 0·7 to 1·0, i.e., by 43%. The difference in the effect of by-passing for fault locations B and C is very small.

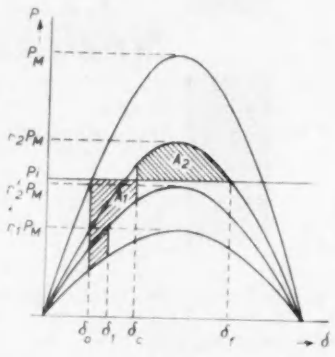


Fig. 2. Curves illustrating the four different power angle characteristics to be considered when applying the "equal areas" criterion to stability of a double-circuit line with series capacitors

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N.J.A.C. Progress

JOINT consultation in the supply industry in England and Wales is examined in detail in the annual report of the National Joint Advisory Committee published, in most attractive form, last week. In a foreword to the report, Sir Robertson King, who is chairman of the NJAC, comments especially on "the success with which both generation and distribution Local Advisory Committees are tackling local problems." He remarks that electricity supply requires for success something more than technical and administrative efficiency: "It requires also a sense of mutual responsibility and fellowship in all who contribute to the service we provide."

It is generally agreed that the effectiveness of joint consultation rests on the performance of the 463 local advisory committees, 259 of them area board committees, 194 in the divisions, and the rest headquarters and project group organisations. Density of committees still varies considerably. At one extreme are LAC's which cover the whole of the sub-area of an area board; at the other, LAC's at small power stations. At the end of the period covered by the report, the typical committee had 15 members, of whom about five were nominated by management and the rest elected representatives of staff.

Efficiency was the subject most frequently discussed by LAC's during 1959-60. The national report speaks of evidence of general improvement of quality of discussion at meetings, and a wider recognition of the desirability of rounding off discussions with positive recommendations.

During the year reviewed, 119 suggestions were submitted for national consideration and 63 were circulated nationally for application where appropriate. Monetary awards totalling £4,235 were made under the suggestions scheme.

Electrical equipment of cranes

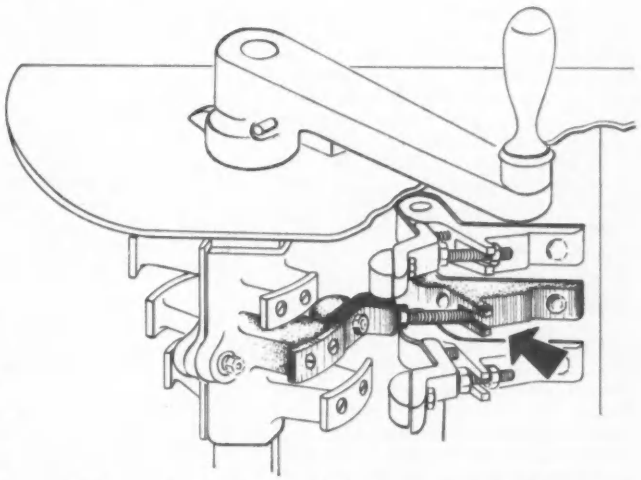
FACTORS IN DESIGN AND MAINTENANCE FOR SAFE OPERATION

ELECTRIC cranes have now been an indispensable part of workshop equipment for many years. It is, therefore, somewhat surprising to learn that many in use still fail to come up to agreed standards of safety in so far as the design of electrical control and collector equipment is concerned. Yet such is the case that the Senior Electrical Inspector of Factories has, in his recent report,* found it necessary to review the general run of problems which are to be encountered and suggest ways of overcoming them.

Unlike the building crane, which has undergone radical changes in design over the past decade, the workshop types have changed but little. Ranging from cab controlled gantry types, capable of lifting loads up to 100 tons or more, to the lighter floor controlled models, either gantry, monorail or fixed, they all represent a potential shock hazard unless properly designed and maintained.

Guarding Trolley Wires

Taking first the gantry crane with a minimum of one hoisting motor, one long-travel and one cross-traverse motor, all controlled from the cab, the first point of hazard is the trolley wires. In some cases these are situated at the end of the gantry remote from the cab, but more often they are adjacent to and behind the cab where, unless they are suitably protected, they are within reach of the driver. Another point where they can be within his reach is at the access ladder. At both of these points they should be so protected by boarding that they are inaccessible to the driver either through the cab windows or when entering and leaving the cab.



Slack or unlocked contact retaining nuts can result in a jammed controller

Similarly the collector wires and collectors supplying the hoist and cross-traverse motors on the gantry must be so placed that they are inaccessible to the driver should he have to go out on to the platform or to maintenance personnel engaged on other duties in the vicinity of the crane. Heavy gauge conductors on the larger cranes usually need metal mesh guards to provide adequate protection. These guards must incorporate substantial mesh material; chicken run netting will almost invariably suffer early damage or corrosion.

Catenaries and Cable Drums

Where movement of the crane is limited, insulated cables may replace the trolley wires. Tough rubber sheathed cables are used for this purpose which may be catenary wire supported—self-coiling cables are sometimes employed—fed from a spring-loaded drum on the crane or on the adjacent building structure or may even be trailed in an open trough. Whatever the method employed, careful maintenance and frequent inspection of the cables and terminations is essential, as the risk of abrasion is by no means negligible.

Underfloor Conductors

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Determination of the Critical Angle

The critical angle and maximum duration of capacitor by-passing are obtained as follows:

From the theory of "Equal Area Criterion," the area A_1 (Fig. 2) is equal to the area A_2 to maintain the transient stability. Therefore

$$(\delta_f - \delta_0)\, P_i = r_1 P_M \int_{\delta_0}^{\delta_1} \sin\delta\, d\delta + r_2' P_M \int_{\delta_1}^{\delta_c} \sin\delta\, d\delta + r_2 P_M \int_{\delta_c}^{\delta_f} \sin\delta\, d\delta$$

or

$$(\delta_f - \delta_0)\sin\delta_0 = r_1(\cos\delta_0 - \cos\delta_1) + r_2'(\cos\delta_1 - \cos\delta_c) + r_2(\cos\delta_c - \cos\delta_f)$$

but $\delta_f = \pi - \sin^{-1}\left(\frac{\sin\delta_0}{r_2}\right)$

therefore

$$\cos\delta_c = \frac{\left[\pi - \delta_0 - \sin^{-1}\left(\frac{\sin\delta_0}{r_2}\right)\right]\sin\delta_0 - r_1\cos\delta_0}{(r_2 - r_2')} - \frac{(r_2' - r_1)\cos\delta_1 - r_2\sqrt{1 - \left(\frac{\sin\delta_0}{r_2}\right)^2}}{r_2 - r_2'} \quad \ldots (5)$$

In the equation (5) for δ_c, δ_0 is determined from the initial conditions and δ_1 is found for a given fault clearing time by "Point-by-Point" method of calculating the differential equation:

$$\frac{d^2\delta}{dt^2} = \frac{\pi f}{H}[P_M \sin\delta_0 - r_1 P_M \sin\delta]$$

for the interval during which the generator rotor moves from δ_0 to δ_1 (fault clearing time t_1). Other quantities in Equation (5) are determined by solving the network for different fault locations; so that the angle δ_c can now be determined.

After clearing the fault, the time t_c corresponding to the angle δ_c is found by "Point-by-Point" method from the solution of the differential equation.

$$\frac{d^2\delta}{dt^2} = \frac{\pi f}{H}[P_M \sin\delta_0 - r_2' P_M \sin\delta]$$

then

$$t_d = (t_c - t_1)$$

System Calculations

Data for a 400 kV, 900 km, 600 MVA transmission system are as follows:

$X'_d = 0{\cdot}3$ p.u.
$X_t = 0{\cdot}1$ p.u.
$X_l = 0{\cdot}9$ p.u.
$K = 0{\cdot}6$
$H = 3{\cdot}3$ kW-sec/kVA
Base power = 600 MVA
Base voltage = 400 kV

The calculations are for a fault clearing time (t_1) of 0·1 sec and for the fault locations A, B and C in Fig. 1.

The curves of transient power stability limit, P, as a function of the maximum permissible duration of capacitor by-passing (t_d) are also shown in Fig. 1.

Conclusions

The curves, Fig. 1, show the maximum permissible duration of series capacitor by-passing in the healthy line as a function of the power transmitted. These curves can be used for designing suitable spark-gaps to give the permissible quenching times for given values of power transmitted while maintaining transient stability of the system.

The effect of decreasing the quenching time can be seen in the curve for fault location A. If the by-passing duration of the capacitors is reduced from 0·39 sec to 0·075 sec, the transmitted power can be increased from 0·7 to 1·0, i.e., by 43%. The difference in the effect of by-passing for fault locations B and C is very small.

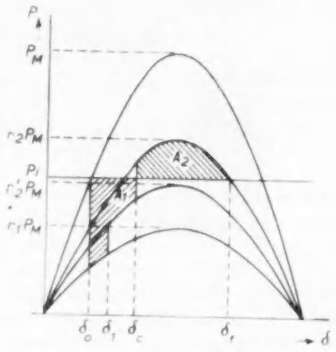

Fig. 2. Curves illustrating the four different power angle characteristics to be considered when applying the "equal areas" criterion to stability of a double-circuit line with series capacitors

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N.J.A.C. Progress

JOINT consultation in the supply industry in England and Wales is examined in detail in the annual report of the National Joint Advisory Committee published, in most attractive form, last week. In a foreword to the report, Sir Robertson King, who is chairman of the NJAC, comments especially on "the success with which both generation and distribution Local Advisory Committees are tackling local problems." He remarks that electricity supply requires for success something more than technical and administrative efficiency: "It requires also a sense of mutual responsibility and fellowship in all who contribute to the service we provide."

It is generally agreed that the effectiveness of joint consultation rests on the performance of the 463 local advisory committees, 259 of them area board committees, 194 in the divisions, and the rest headquarters and project group organisations. Density of committees still varies considerably. At one extreme are LAC's which cover the whole of the sub-area of an area board; at the other, LAC's at small power stations. At the end of the period covered by the report, the typical committee had 15 members, of whom about five were nominated by management and the rest elected representatives of staff.

Efficiency was the subject most frequently discussed by LAC's during 1959-60. The national report speaks of evidence of general improvement of quality of discussion at meetings, and a wider recognition of the desirability of rounding off discussions with positive recommendations.

During the year reviewed, 119 suggestions were submitted for national consideration and 63 were circulated nationally for application where appropriate. Monetary awards totalling £4,235 were made under the suggestions scheme.

Electrical equipment of cranes

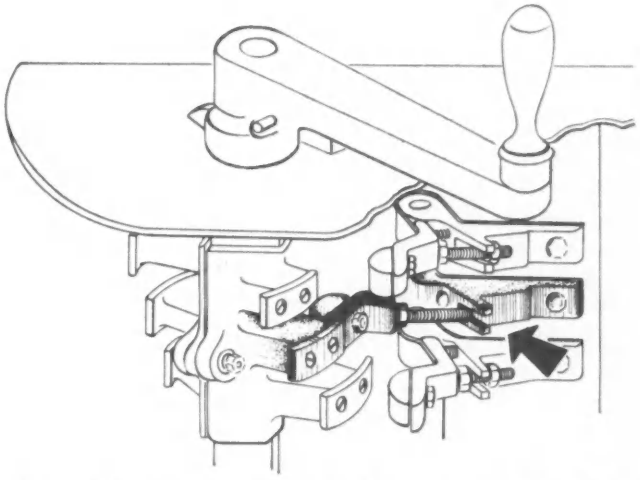
FACTORS IN DESIGN AND MAINTENANCE FOR SAFE OPERATION

ELECTRIC cranes have now been an indispensable part of workshop equipment for many years. It is, therefore, somewhat surprising to learn that many in use still fail to come up to agreed standards of safety in so far as the design of electrical control and collector equipment is concerned. Yet such is the case that the Senior Electrical Inspector of Factories has, in his recent report,* found it necessary to review the general run of problems which are to be encountered and suggest ways of overcoming them.

Unlike the building crane, which has undergone radical changes in design over the past decade, the workshop types have changed but little. Ranging from cab controlled gantry types, capable of lifting loads up to 100 tons or more, to the lighter floor controlled models, either gantry, monorail or fixed, they all represent a potential shock hazard unless properly designed and maintained.

Guarding Trolley Wires

Taking first the gantry crane with a minimum of one hoisting motor, one long-travel and one cross-traverse motor, all controlled from the cab, the first point of hazard is the trolley wires. In some cases these are situated at the end of the gantry remote from the cab, but more often they are adjacent to and behind the cab where, unless they are suitably protected, they are within reach of the driver. Another point where they can be within his reach is at the access ladder. At both of these points they should be so protected by boarding that they are inaccessible to the driver either through the cab windows or when entering and leaving the cab.



Slack or unlocked contact retaining nuts can result in a jammed controller

Similarly the collector wires and collectors supplying the hoist and cross-traverse motors on the gantry must be so placed that they are inaccessible to the driver should he have to go out on to the platform or to maintenance personnel engaged on other duties in the vicinity of the crane. Heavy gauge conductors on the larger cranes usually need metal mesh guards to provide adequate protection. These guards must incorporate substantial mesh material; chicken run netting will almost invariably suffer early damage or corrosion.

Catenaries and Cable Drums

Where movement of the crane is limited, insulated cables may replace the trolley wires. Tough rubber sheathed cables are used for this purpose which may be catenary wire supported—self-coiling cables are sometimes employed—fed from a spring-loaded drum on the crane or on the adjacent building structure or may even be trailed in an open trough. Whatever the method employed, careful maintenance and frequent inspection of the cables and terminations is essential, as the risk of abrasion is by no means negligible.

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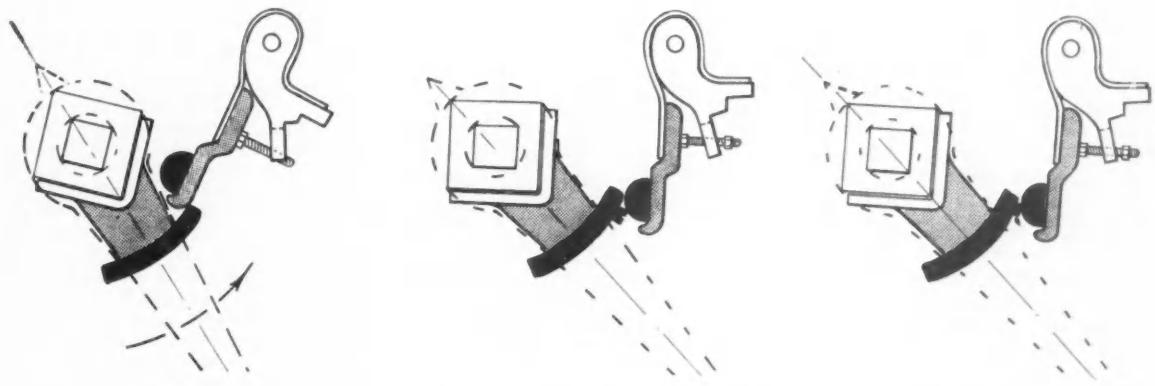


Some common contact faults. Left, a loose contact tip. Centre, a loose screw. Right, welded contacts. All of these can cause a jammed control and may lead to disastrous results

Drivers' cabs

There has been some improvement in driver's cab design in recent years, giving him better protection from draughts, comfortable arrangement of controls, improved seating and, of course, full view of and around the load being lifted.

It is desirable that the relevant positions and direction of rotation of the controls should be standardised throughout the factory, and the mechanism of the handles must be such that they cannot accidentally be moved from the "off" to the "on" position. Isolating switches on the cab should be provided so that the driver can make the crane "dead" before leaving. An additional isolating switch adjacent to the access point should also be provided to make the trolley wires dead for maintenance and cleaning purposes.

Limit Switches

Limit switches are provided at each end of the cross-traverse and long-travel and also at the upper limit of the hoist. The circuit must be so arranged that further travel in that direction is prevented without, however, preventing movement away from the limit switch. The switches themselves must be set to cut off the current and apply the brakes sufficiently early to allow for any over-travel through momentum. Buffer stops can be provided at the extreme of long-travel and cross-traverse, but are rarely applicable to the hoist.

Some crane drivers tend to rely on the limit switch to stop lift or travel and do not exercise sufficient care. This is a bad practice which should be curbed, but the design of the limit switches should be robust enough to withstand some amount of misuse. Co-ordination between brake adjustment and limit-switch setting is essential for good operation and, if the responsibility of two men of different trades, should be carried out jointly in a single operation.

Limit switches on cable drums will depend on the length of cable unwound for their operation though nominally related to the position of the gantry or carriage. If the cable should stretch, the adjustment will not prevent the gantry or carriage from meeting the buffer stops with some force.

Maintenance of Contacts

On all forms of controller the contacts are subject to wear and will eventually require adjustment or replacement. Care must be taken in this operation, particularly when the contacts are attached by screws, nuts and bolts or studs. The omission of a lockwasher or locking nut may allow the contacts to work loose with disastrous results. Some of the possible contact faults are shown in the diagrams on the previous page.

Floor-operated Cranes

Floor-operated cranes are, for the most part, controlled by push-buttons from drop lines. These drop lines have given a great deal of trouble and, at the very least, the supporting cable and the connecting cables should be separate. That is to say, the multi-conductor cable should not, by itself, take the weight of the control unit.

Chain-operated switches, on the other hand, offer the hazard that they may be inadvertently pulled by passing loads, the operator tripping or through similar causes, setting the crane in motion. The controller should always incorporate a prominent mushroom-headed "stop" button which opens the main switch, making all circuits dead.

Lifting Magnets

Lifting magnets are used extensively in the steel industry for handling scrap and billets. The hazard here is of inadvertent failure of the d.c. supply to the magnet causing it to drop its load without warning. Single large pieces of steel are more easily handled than scrap, which may tend to shed part of its load even when the magnet is fully excited. Operators know this and take precautions when handling loose scrap but may be caught unawares when handling single pieces. The remedy is to float a battery —nickel type for preference—across the magnet circuit which is kept charged automatically and which instantly takes over in the event of a power failure.

Maintenance of the electric equipment of cranes is an important and responsible duty. It must be carried out at regular intervals and with full regard to the safety of the maintenance man. After all, if the maintenance engineers are inclined to take risks, what sort of example do they show to the crane drivers and operators?

ARC FURNACE TRANSFORMERS

NOW that more steel makers are installing arc furnaces, it behoves the maintenance engineer, if he has a say in the matter, to choose a transformer which will cause him the least anxiety. The arc furnace transformer does not differ appreciably from thousands of others which continue to give good service year after year, except in the matter of off-load tap changer operation, the tap changer operating some ten times during each melt. Thus it is rather a vulnerable piece of equipment, although not all faults in the tap changer are dangerous ones. However, only a slight misalignment between the tap changer position and the interlocks will prevent the circuit-breaker closing.

The position of the tap changer is therefore most important; it should be situated towards the top of the tank immediately under the inspection cover, or as near to this position as is practicable, so that it is only necessary to remove a small amount of oil in order that the cover may be taken off and the fault remedied. With the tap changer situated lower down in the tank, hundreds of gallons of oil may have to be removed and the heavy cover plate manhandled before the tap changer can be reached and worked upon. It is extremely annoying to have to spend all this time in order to deal with a fault that can be rectified by the tap of a hammer or the turn of a spanner, a matter of a few minutes' work.

The tap changer itself should be no more complicated than a manually operated crane controller and the interlocks should be simple, with plenty of positional latitude. It should not be necessary for the driving motor to stop dead in order to avoid an over-run.

Oil in the tap changer should be as separate from the main compartment as it is possible to make it, without going to the limit and making the compartments entirely separate. In this way, any carbon contamination of the tap changer oil is not circulated around the main transformer windings.

The most dangerous fault which occurs on a tap changer is bad contact, which leads to sparking and contamination of the oil. This could, in a matter of days, or even hours, cause a complete shut down. If the oil is common to both transformer and tap changer the carbon is deposited in the e.h.t. windings, and even if these windings do not break down at the same time as the tap changer they are almost certain to do so at a later date, since it is impossible to remove the carbon deposits entirely.

Some transformer manufacturers recommend that the oil be drained from the transformer every 12 months and an inspection made of the tap changer. It is difficult to see what this will achieve. The comprehensive test of a sample of oil taken from the transformer tank gives quite an accurate picture of the transformer condition and, apart from excessive acidity, the oil should not require to be changed in less than ten years. An annual inspection of the tap changer will be little use either, because the chance of forestalling a fault which can only last a few days when it develops is very remote. Apart from this, to remove and store thousands of gallons of oil in a clean, dry condition is a major operation.

A bad contact in a circuit with a steady load would be detected quickly by the fluctuating ammeter reading, but the violent fluctuations of current which are a feature of the arc furnace prevent a fault in the tap changer being detected in this way.

The answer to the uncertainty of the condition of the tap changer seems to be the fitting of a toughened glass panel in the side of the tap changer compartment. This would allow constant inspection of the oil condition from floor level. Even a short period of sparking will blacken the oil, so that a fault could be detected in the early stages and, if the tap changer inspection lid were placed on the top of the tank, quickly remedied.

The maintenance engineer should not have to accept any responsibility for the breakdown of the arc furnace transformer if he has taken regular samples of oil and has had them tested by a competent authority.—*L. Smith.*

Aspects of Automation

BRITISH TECHNIQUES DISCUSSED IN MOSCOW

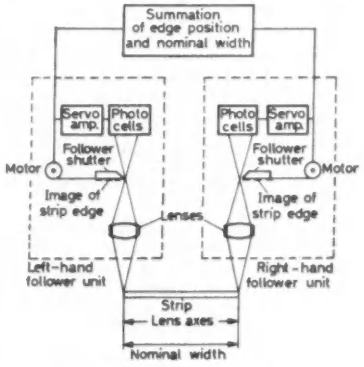
IN Moscow this summer, a meeting was held of the International Federation of Automatic Control. A number of UK papers were presented at this meeting, and recently these were considered at a symposium organised by the Institution of Mechanical Engineers.* Many of the papers are concerned with highly theoretical aspects of automatic control design, but there are a number which give an intriguing picture of the way automation is developing in British industry.

The steel industry has been amongst the most active exploiters of the possibilities of automatic control. An example of the ingenious instrumentation that has been developed is the strip width meter, several of which are in operation. The sort of performance given is an accuracy of ±0·030 in. with range of measurement 3 in. to 24 in. on a hot-strip mill. The instrument is rugged enough to permit mounting the follower units only 6 ft above the fast-moving strip. Fig. 1 shows the basis of the instrument. Two photo-electric edge follower units are mounted vertically above opposite edges of the strip. In connection with the optical system, there is a servo-operated shutter edge automatically following the hot edge of the strip. Independent movements of the two shutter edges are monitored and added together to indicate width of strip, independent of the inevitable shake which makes more static methods of measurement impossible. The instrument can cope with 6 in. movement of each edge of the strip in a lateral direction.

More sophisticated is another technique now under development for measuring strip speed in strip mills. This uses two sharply defined intense spots of light directed on the moving surface, in line with the direction of motion, and reflected from the surface into photocells. The varying texture of the surface produces varying signals from the photocells. If the signal from the upstream cell is delayed and then compared with that from the downstream cell, a delay can be found at which the two waveforms are in step. This delay is a function of strip speed. So far, experiments indicate that with cold-reduced steel an accuracy of ¼% can be achieved in the speed range 100 ft/min to 1,000 ft/min. Use of a servo system to control the delay setting could give direct reading of speed.

Bicycle Wheels

A high degree of mechanical complexity is involved in some automated equipment. An example of the taking over of a highly skilled but monotonous manual job comes from the bicycle manufacturing industry. The task is the building of a bicycle wheel. This involves tightening the spokes by nipples fixed to the hub and rim of the wheel, with tensions in the spokes adjusted so that the wheel runs true. Spoke tension has to be made high enough to prevent distortion of the wheel in service, but not so high that breaking occurs under the working load.



Schematic diagram for steel hot strip width measurement

In the automatic machine, the wheel is held in a jig and a measuring head operating with reference to the rim of the wheel is fixed by an arm centring on the hub. Each of the spoke nipples is introduced into a box spanner, each box spanner having its own driving motor. The measuring head contains two double-wound U-shaped laminated cores with the primaries excited at 400 c/s. One head measures the gap in the radial direction, the other the gap in the vertical direction (the wheel being held horizontal) and, hence, the deviation of the rim from the rotational plane of the measuring arm.

Once the wheel is set up the arm rotates and signals representing the rim positions in the two planes are developed. These signals control the running of appropriate motors, non-circularity being dealt with by tightening spokes to reduce the immediate radius, distortion in the plane of rotation by tightening spokes fixed to one side of the rim only. The machine also includes provision for tightening *all* spokes at stages in the cycle, so that none are left entirely slack. The spanner-driving motors are arranged to stall when maximum acceptable spoke tension is reached.

This machine has enabled unskilled female labour to be used to produce one wheel every minute.

Position Control

Much of the work on automation has concerned position control of machine tools. Amongst the Moscow papers was a description of the Helixyn system, in which a cylindrical bar, somewhat longer than the distance over which control is required, is used, surrounded by a short cylindrical sleeve which moves along the bar, but not in contact with it. The two parts are mounted on the machine tool so as to pick up the relative motion which is to be controlled

The sleeve consists essentially of a tube of insulating material, the inside surface of which supports four distinct helical conducting paths. These are arranged with equal axial spacing so that they form a regular interlaced pattern. The bar has three interlaced patterns carried on a layer of insulation bonded firmly to a steel tube. The lead of the helices on the bar is the same as that on the sleeve and the design is such that variation in capacitance between each sleeve conductor and each bar conductor is closely sinusoidal when plotted against relative axial movement.

In use, the sleeve conductors are supplied with a.c. or impulse voltages at a sign and magnitude set by a relay-switched resistor network. The switching is controlled by numerical input (from a keyboard or punched tape) and operates so that the electrostatic field between bar and sleeve remains substantially constant in form but takes up an axial position relative to the sleeve, bearing a linear relation to the numerical input. The result is an order of accuracy of positioning of 0·0001 in.

Control in Sugar Production

In the chemical industry, automatic control has been carried to the point where complex operations are under computer control. An example is processing sugar beet. Here the rate at which various stages of the process are proceeding is adjusted to keep intermediate tanks full to a pre-arranged level. Electronic computers are used and they take account of the time constants associated with the various stages of the process to keep the work proceeding steadily.

Papers mentioned above are those by Messrs L. N. Bramley, S. S. Carlisle and R. B. Sims (steel); A. V. Hemingway and R. L. Dressler (bicycle wheels); D. J. Mynall (position control); and J. Campbell MacDonald (sugar processing).

* The papers presented to the Moscow Conference, foreign as well as British, are being published by Butterworth's Scientific Publications Ltd.

Ergonomics in Industry

THE MODERN APPROACH TO GREATER PRODUCTIVITY

ERGONOMICS—the study of man in his working environment—is a comparatively new science. It springs from the earlier sciences of work study, industrial psychology and industrial design in relation to machine tool layout, workshop planning, lighting and décor. In fact, it may be considered as the combination of all these sciences into a co-ordinated study.

The new science first received its impetus during the war when the design and use of service equipment became vitally important. In the post-war period it has developed considerably, with striking results on productivity and the general health and well-being of workshop and office personnel.

The Scope of Ergonomics

Any productive process may be considered as the co-ordination of machine and operator capacities within a shell of environment. Both environment and machine are capable of being designed, planned and adjusted within almost infinite range; operators, on the other hand, have capacities which are limited by their personal physiques, mental capacities and other factors which are incapable of alteration or adjustment beyond that of stimulating latent abilities by training or education. It therefore follows that the operator is the governing factor in a productive process. Once the parameters of physiological and psychological requirements for a particular task have been set and the operators chosen who possess these requirements, the ultimate output from the machine-operator combination will depend largely upon the degree of skill with which the control functions of the machine are presented to the operator and the environment in which he is working.

There are certain factors which are broadly complementary in the man and the machine. The link between them is the controls. The maximum capacity of the machine in size and weight per workpiece is complementary to the physical strength of the man; the sensitivity, accuracy and consistency of repetition of the machine is complementary to the psychological make-up of the man, his mental capacity, keenness of perception and response to mental stimuli. Both man and machine are subject to a fall-away in performance which may be temporary—adjustable wear in the case of the machine; fatigue in the case of man—and rectifiable by a short period of rest and maintenance, or permanent through age.

The performance of the machine may suffer through environmental factors, such as the presence of corrosive atmospheres, dust and grit and, in some cases, excessive atmospheric humidity and temperatures. The complementary environmental factors in the case of the man are lighting, ventilation, outlook, attitude and noise.

The ergonomist, appreciating these factors, strives to link the operator with the machine in such manner that he is able to exercise control with the minimum of physical and mental stress and to so arrange the environment that the productive effort may be maintained for the longest periods without excessive fatigue. These broad principles apply whether the machine is a relatively simple tool, such as a pair of scissors, a complex machine tool with simultaneous control in two or more directions at differing rates or the even more complex task of controlling and navigating a high speed aircraft. The tailor, working at the cutting-bench, uses scissors which have been designed to fit the hand comfortably and with blades cranked at the most convenient angle; their continued efficiency as a cutting instrument depends on the maintenance of sharpness at the cutting edges and on the degree of wear in the rivet and rivet-hole.

Ergonomics Research

In Britain the study of ergonomics is centred in the Ergonomics Research Society.[1] This body was formed by a group of research workers who, during the war, had been members of teams formed to study physiological and psychological methods for the best means of measuring fighting efficiency, safety and comfort of all forms of combatant under varying conditions of environment. The groups included anatomists, engineers, physiologists, psychologists and industrial medical officers. At the end of the war the teams were broken up but in 1949 some members met to discuss research in this field and, at the meeting, it was decided to set up an organisation to carry on the work with particular application to industry. The term "ergonomics"—from the Greek "Ergon," work, and "nomos," law—was coined for the new study.

The Society has the close co-operation of, and works in association with, the DSIR, the Medical Research Council, the Universities and many industrial research associations. It was the Society which requested the DSIR to promote the recent Conference on Ergonomics at which industry was shown some of the results of recent research and how the results were being applied to a wide variety of industrial problems. Lord Hailsham, Minister for Science, opening the conference, referred to the basic ergonomic study of "time and motion" and stressed that the degree of industrial unpopularity which was accorded to it was primarily due to the limited range of the study. Today the TUC is one of the strongest supporters of ergonomics.

The Human Factors

The human factors can be broadly divided into the allied physiological and psychological groups of study. Psychology is a wide subject of which one aspect, covered by the term "experimental psychology," is the concern of the ergonomist. This study relates to man as a control mechanism taking in information and using it to guide his actions. The psychological aspect of fatigue has little connection with muscular fatigue and its effects are different. Whereas muscular fatigue leads to loss of performance and erratic, nervy behaviour, the psychological counterpart, boredom, leads to loss of vigilance and/or drowsiness. Boredom can, however, be dissipated by novelty or change of aim. Some of the most strikingly boring jobs are those which under-load the operator but never allow him time to divert his attention to other things.

This aspect may have some bearing on the reason why some light repetition tasks are particularly suited to women. The lesser degree of physical demand tends to create a sense of boredom in the more physical male whereas a similar repetitive task, such as operating a capstan lathe, calling for more muscular effort does not have the same effect.

The psychological factors are also of importance in the relations between individuals. For complete accord, there must be some common pattern of observation, interpretation and translation of information into action. Upon this will depend the accuracy with which an instruction, verbal or written, from one person to another will be carried out.

Sometimes a simple instruction is difficult of understanding without some background knowledge to assist. Welford quotes an example of training girls in so-called "invisible mending" on woollen materials in which the pattern of weave is faithfully copied. The training period seemed unduly long until the idea was conceived of showing the girls how the weaves were originally constructed. The girls were enabled to construct the weaves on a large frame and to do the first mends on specially woven large scale cloth. The reduction in training time was dramatic.

This article is based upon a series of papers presented at the DSIR conference on "Ergonomics in Industry," London, 27-29 Sept., 1960.

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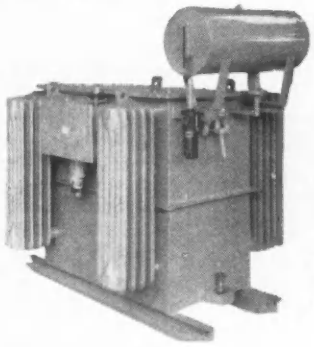

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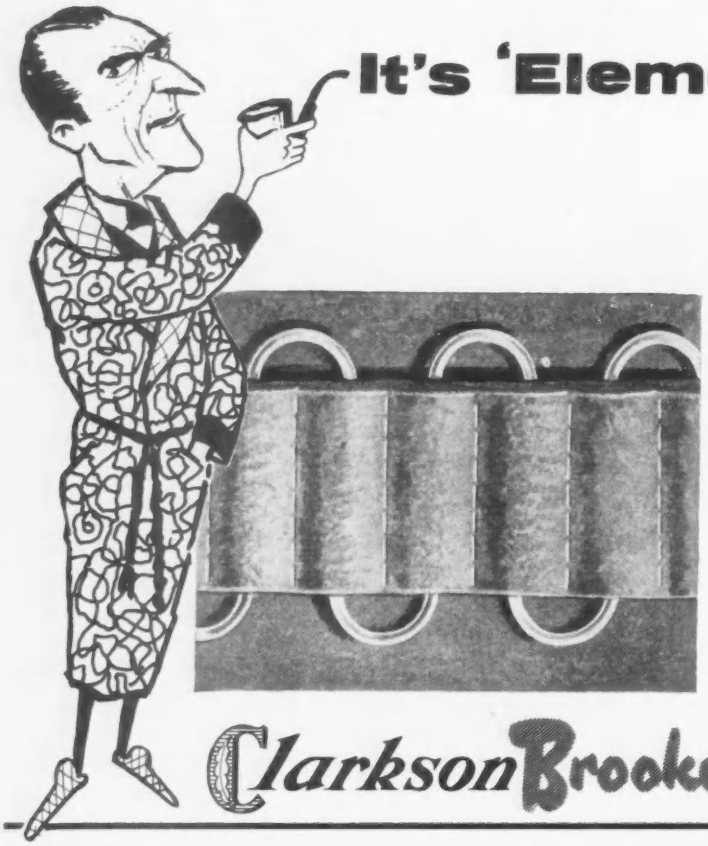

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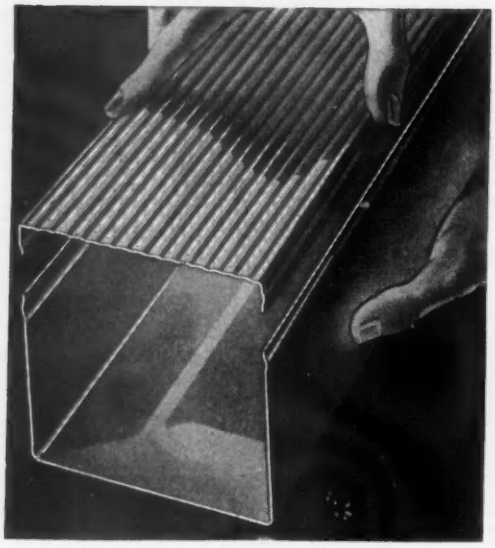

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The Physical Aspect

Most people think that they have an idea of what constitutes physical work. The common impression that muscular energy is used only when some form of motion is in progress is incorrect. Try holding a heavy weight at arm's length for a long period and you will soon experience muscular tiredness. There is, for every muscle, a position at which the demands for energy are at a minimum. A knowledge of this in relationship to the positioning of the control is important in combating muscular fatigue. Murrell mentions an incident in which the angle of an accelerator pedal of a car was set so that, for the idling position, the ankle was bent backwards some 20° from the natural position. The result was early muscular fatigue resulting in a tendency to drive the car faster than road conditions warranted.

Another aspect of physical fatigue arises from the disturbance of normal working cycles. The changeover from day to night shift working is accompanied by a falling off in output until the body has accustomed itself to the new cycle. This may take 4 to 5 days. Practically all muscular fatigue can be reduced by intermittent rest periods and the timing of operations to include properly proportioned rest periods from muscular effort, without necessarily breaking the mental effort, can have surprising results on output. Both physical and psychological fatigue are dependent on environmental conditions and one in particular, the attitude or position of the body, whether sitting or standing, is of vital importance. This is part of the extensive anthropometric studies which have arisen out of early investigations into the most satisfactory attitude for pilots and crew of aircraft, drivers and gunners of fighting vehicles, submarine crews and other service personnel during the war.

The same study, projected into industry, is of vital importance to the designer of office furniture, the planning of control positions in vehicles, crane cabs and before control desks. The anatomical and physiological principles have been well studied and are taken into account in British Standard 3044 on school furniture. The same principles have equal importance in industrial design.

Despite mechanisation, there are still a surprisingly large number of locations in industry which demand muscle power from the seated position. The limits of effort available and the angles at which the force can be applied without exceptional fatigue must be known to the designer, and a great deal of study has already been given to the subject. In lifting operations, the amount of effort which can be applied from the standing position is considerable. Unless the limiting loads for the individual are known, there is danger of back injury which, in the case of young people and women, is prescribed by factory regulations.

Ergonomics and Design

It follows that the studies of the psychologist, physiologist and anthropometrist are of vital importance to the machine designer. It is common to talk of the "average" man but, as Weiner says, the anthropometrist does not cater for the average man. There is such a measure as an average value but almost no such thing as a completely average man. For any individual measurement perhaps 20% to 25% of a population might be said to congregate at the mean but, of these, only a fraction would be average in another dimension. The anthropometrist's solution is to use two mannikins—simple models with the main measurements—to cater for 90% of the range which are combined with photographs to make sure that posture and movements from the control position are correct.

Many of these measurements are tabulated with mean and standard deviations and the information is invaluable to the designer but, for the moment, they exist only in widely scattered monographs and reports; a handbook combining them would be of immense value.

Another aspect of machine design is the positioning and grouping of the various indicators which give the operator the information on which he makes his decisions. It is fundamental that the associated indicators and controls should be so grouped in relation to each other that the minimum of mental effort and physical movement is exerted in identifying the message and making the appropriate action. Equally important but less obvious is that there should be relation between the movement of the indicator needle and the related control handle.

For handwheels associated with circular scales, clockwise movement of the indicator needle should correspond to clockwise movement of the control wheel. Other relationships also commend themselves to the thinking designer.

On the subject of grouping, where a large number of indicators are mounted together, sub-grouping into related sections is an aid to easy location. In regard to the form, shape and colour of the indicators and the size and style of the markings, Spencer, in his paper, makes practical recommendations on the strength of a study carried out at Reading University.

Three basic designs are included in the study; moving pointer, moving scale and cyclometer. Merits differ and the choice depends much on the application and location. The main features, however, are that black and white are the best for scale marks and background, with upright figures in a non-serif style, and the minimum number of scale divisions compatible with the duty. The machine designer and the furniture designer of the future must both be influenced by the work of the ergonomist for the industrialist, seeking higher productivity against an ever increasing wage scale, will find even the smallest detail which assists in increased output a factor influencing his choice of machine.

Environment

Of the five factors mentioned under the heading of environment, attitude of the operator and noise are largely the responsibility of the machine designer. Outlook and ventilation are the responsibility of the architect, who also has some responsibility for noise in that he will decide the form and material of ceilings and wall claddings.

Lighting is a feature of the environment which is not easy to correlate directly with productivity. There is, however, good evidence that better lighting is a factor in improved productivity; certainly poor lighting in the workshop or incorrectly applied lighting greatly increases scrap.

Lighting Principles

The three main principles to be followed are that there should be adequate lighting without glare; that there should be freedom from unwanted shadows and that the work should be the natural focus of attention.

Controlled laboratory tasks have provided a great deal of useful information about lighting levels but the translation into industry must necessarily involve experience as well as experimentation. Recommended levels for most industrial tasks are of the order of 15-50 lumens/sq ft, with the lower figure as the minimum regardless of the type of work in hand.

Glare is one of the most worrying problems in factory lighting today. It can offset the advantages of a well planned lighting installation in other respects and the raising of the illumination levels to such an extent that the better lighting produces a lower output. It may be caused by the direct impingement on the vision of a light source or the reflected image from polished surfaces on or around the workpiece. It reduces the ability of the operator to read his instruments with accuracy, but it may be present without any reduction in his ability to see nor may he be directly conscious of its effect upon his vision.

The problem is complex but the means of avoiding glare have been studied and are well understood. The whole environment must be bright, which means that the surfaces of walls, floors and ceilings are light in colour. Matt finish paints are preferable to prevent reflected highlights and the surfaces should be washable so that the diffuse reflecting qualities are maintained.

The work should be the natural focus of attention. Anything about the work which demands special attention should have local lighting, but local lighting in an otherwise poorly lighted area is bad. This is a common mistake which has frequently been made in the past. Too great a contrast between the light on

the workpiece and the surroundings is liable to induce eye-fatigue, since the constant transfer of the gaze from one point to another will be accompanied by excessive dilation and contraction of the iris in the eye. There must be a proper balance, giving just sufficient contrast to enable the gaze to be transferred from the work area for visual relief without excessive call on eye muscles.

Small workpieces under bench-mounted processes need particular treatment. There must be contrast between the workpiece and the bench surface background. Some reflected highlights from the surface of the workpiece are unavoidable, and, indeed, are advantageous to provide degrees of contrast, but the level of such highlights must be controlled. Since eye response is a variable with different persons, there is something to be said for adjustment of the local bench spotlighting by the operator.

In regard to general lighting, the fluorescent tube has revolutionised factory, office and shop lighting to an extent unimaginable 25 years ago. The rules for height and spacing have now been fully established and the minimum levels at the working plane are laid down in various statutory regulations for factories which reflect the advances in this field. It is important to remember that the levels are minima and are conservative. Factory lighting which only just observes these minima cannot be considered as a good, or even adequate, installation by modern standards.

The P.S.A.L.I. Concept

Not all lighting is from artificial sources. Wherever possible, natural daylight is used, not only because of its effect on lighting bills but because the human preference is for natural daylight where possible. The modern concept of factory and office buildings with large window areas is a recognition of this, for the average worker prefers a window position for his or her desk or bench. Natural light is, however, far more variable in quality and intensity than artificial light and needs some form of shading during the height of summer or in the late autumn and spring days when the sun is low on the horizon. At the other extreme, on cloudy or foggy days, some assistance from artificial lighting is essential.

In large buildings, where the floor area extends well back from the windows, natural lighting by itself, even on the sunniest days, is inadequate and must be supplemented by artificial lighting. While the American idea of a totally artificial indoor environment, excluded from natural light and ventilation, is not likely to appeal to the British people —perhaps because our climate is not so extreme as in many parts of the American continent—some permanent daytime lighting will inevitably be part of the future modern office or factory installation.

This aspect has already achieved some attention and the concept of mixed natural and artificial lighting has been studied at the Building Research Station and the elements of a basic mixed lighting system—PSALI, permanent supplementary artificial lighting for interiors—are now established. Fully developed, it may mean a reduction in the window areas below the present purely architectural levels and an increased amount of permanent artificial lighting to produce an evenly balanced overall illumination throughout the day.

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Another point which the ergonomists have brought to light relates to the modern practice of grouping controls at a central point remote from the process. At first sight this might seem to solve the fatigue problem in that physical effort is reduced considerably by centralisation of observation. In point of fact the operator now has to visualise an operation in terms of the mimic displays and indicators instead of actually watching the operation, with all the minor indications which assist him in his judgment. The mental processes involved in translating the numerical values and positions on the indicators into a picture of the actual conditions represents a considerable psychological load. In fact, the physical stress has been transformed into substantial perceptual and decision-making load which is just as much responsible for fatigue as manual labour. But that is only one aspect of centralised control.

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This incident shows a clear distinction between ergonomics and the earlier attempts to launch time-and-motion studies. Whereas time-and-motion studies in the past have not always received the support of industrial workers and, in some instances, have been violently opposed, ergonomic studies, by their broader and more encompassing aspect, have invariably secured industrial co-operation at all levels. It is a long cry from the initial work of Frank and Lilian Galbraith who, some 50 years ago, launched their ideas on work study to an incredulous world. Part of the opposition may have been due to the errors of psychology in presenting the techniques to the worker in industry but, since psychology is part of the ergonomic study, it is natural that presentation of the idea is based on the right psychological approach.

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Industrial electrical drives

CHAIRMAN'S ADDRESS TO I.E.E. UTILISATION SECTION

WIDELY used in industrial fabrication processes, variable-speed drives, together with their control systems, offer the biggest scope for technical developments amongst industrial electrical systems. It is, in fact, in this field where most recent advances have taken place. This point is made in the inaugural chairman's address to the IEE Utilisation Section by Mr J. M. Ferguson, B.SC.(ENG.), M.I.E.E. (EE Co.). Constant speed drives are, in the main, catered for satisfactorily by the squirrel-cage induction motor. The advantage of its relative cost over other motor types is illustrated in Fig. 1. The basic design of the squirrel-cage motor would appear to have reached the ultimate and development is confined to increasing ratings and provision of special enclosures for specified duties.

D.C. Variable Drives

For variable-speed performance, the position of the d.c. motor is still unchallenged. Over the years there has been little change in its basic concept, rather a gradual evolution and refinement in design. There remains, however, the long-standing commutation problem and much research has been carried out towards overcoming this major disadvantage in d.c. motors. The problem has been aggravated by high rates of change of current imposed by modern control systems. In motors having cast-iron or rolled-steel frames, slow response of main and compole flux, due to frame eddy currents, has an adverse effect on commutation. This difficulty has been overcome by introducing machines with laminated frames.

Parallel to improvements in d.c. motor design, there have been new trends in a.c./d.c. conversion. The traditional rotary converter used for d.c. motor control is beginning to be superseded by static converters. An interesting application is in regenerative drives for reversing mills as an alternative to the universal Ward-Leonard or Ilgner systems. Use is made here of a grid-controlled mercury-arc converter. Regenerative reverse currents are catered for by connecting duplicate installations back to back, or by placing a reversing switch either in the drive motor armature circuit or its field circuit. These connections are shown in Fig. 2. Static converters are also used in packaged power units which provide variable output drives up to 100 h.p. from a 400 V a.c. supply. For these units, increasing use is being made of silicon and germanium rectifiers.

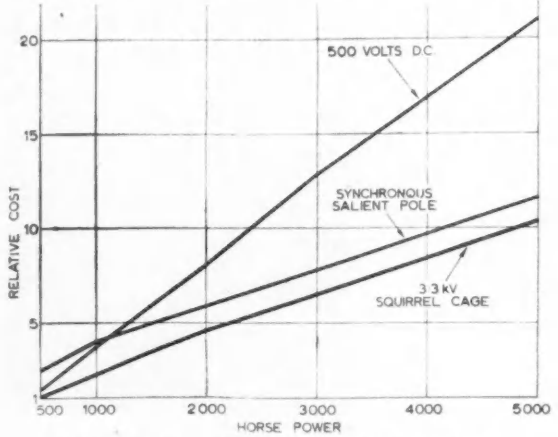

Fig. 1. Relative costs of motors operating at 1,000 r.p.m.

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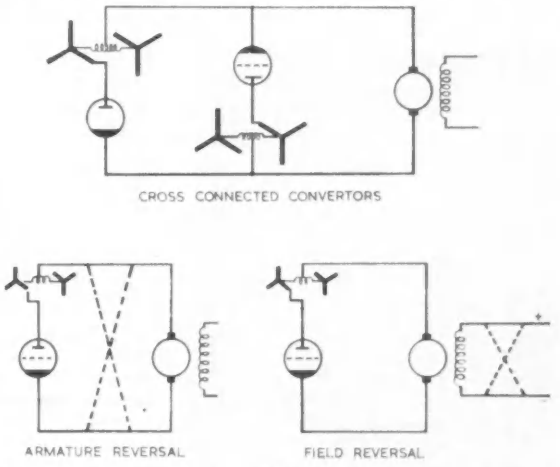

Fig. 2. Systems for reverse current flow with mercury-arc converters

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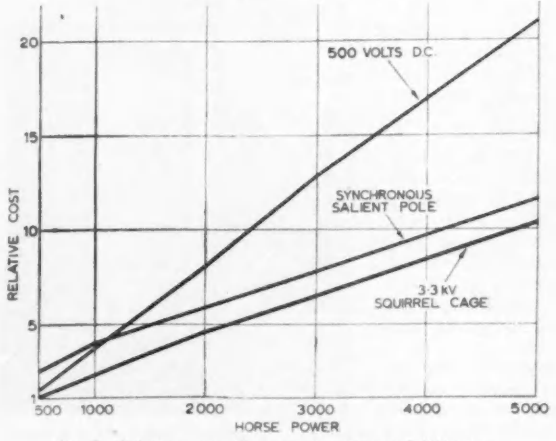

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Control

The value of automatic and semi-automatic control of industrial processes is now clearly recognised and, with the advent of magnetic and transistor amplifiers, the reliability of electronic systems has been proved in practice and is no longer doubted. Many industrial processes lend themselves to automatic control where operations are programmed on punched tape and fed into the system. There has been a recent trend in this direction backed by experience gained in semi-automatic control. Future developments are expected to be in the exploitation of digital computers for automatic supervisory control.

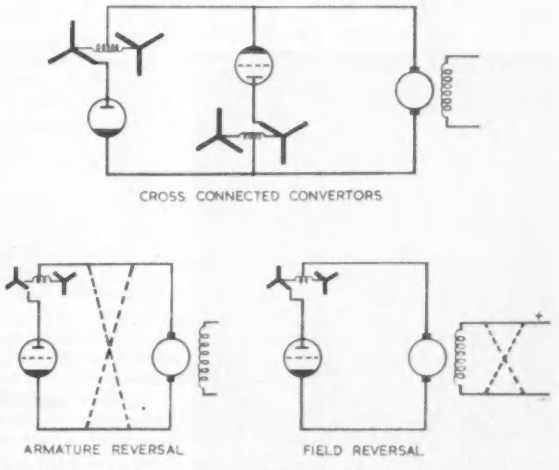


Fig. 2. Systems for reverse current flow with mercury-arc converters

G

for the electrical trade

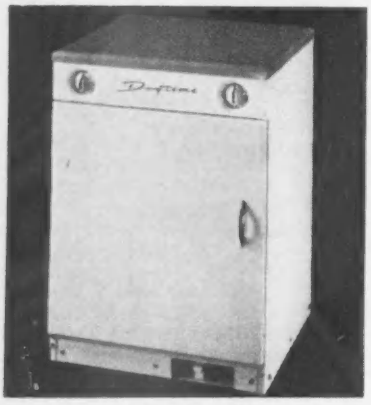
Inexpensive tumble dryer

A TUMBLE dryer with three heats and automatic time control seems good value at £34 13s tax paid. The machine offering these features is "Drytime," a 7 lb capacity model 30 in. high with a flat table-top in red, blue or white. The main square door allows access to the horizontal perforated drum and operates a cut-out device and brake immediately it is opened.

The simply operated controls situated on top right and left of the front panel give three heats, up to 2 kW output, and a drying time of 90 min maximum. "Drytime" has a finish of white stove enamel and stands on three casters. Dimensions 30 in. high by 21 in. wide by 19¼ in. deep. Eight feet of flex and a 6 ft extractor hose are extras. This machine is covered by a year's guarantee and after-sales service. *Wallisdown Electrical Appliances, Wallisdown Rd, Bournemouth.*

Household fire alarm

HOT air from an unseen fire will set off the new battery-powered "Cry-er" alarm when the temperature approaches 140°F. This warning device is designed for domestic installation; it is small, inexpensive and attractively styled. The alarm is simply hung on the wall at a "high spot" in the house where hot air, convected from a fire, would have to pass. The makers recommend one on each floor for complete safety. Powered by two batteries, it produces a wailing sound loud enough to rouse everyone in the household. If good leakproof batteries are employed "Cry-er" should carry on sounding, once activated, for up to an hour. Operating on the bi-metal strip principle it resets automatically once the temperature has dropped and, provided the emergency has been only short-lived requires no further attention apart from a monthly check. The smoothly styled casing measures only 6 in. by 3 in. It is available from stock at £3 19s 6d. *Fire Cry-er Ltd., Jack Bridge Mill, Colden, Hebden Bridge, Yorks.*



"Drytime" tumble dryer, 3-heats and time control, £34 13s

"Neptune" towel drying panel, £9 9s

Warm panels for wet towels

HEATED wall-mounting panels with towel rails are a recent addition to the range of heaters employing the "Mhoglass" mesh-type element. This is an ideal application of the "Mhoglass" element which is rated, so far, at less than 100 W/sq ft. The towel dryer comprises two Swedish masonite boards sandwiching the element and finished in pink, blue or cream stove enamel. The towel rail is placed toward the top of the panel. An output of 300 W is said to keep towels dry and possibly takes the chill off the bathroom. Dimensions: 2 ft by 2 ft. Known as "Neptune," the dryer is simply installed with the fixing accessories supplied. Price £9 9s tax paid. *Morheat Ltd., Church Path, Fareham, Hampshire.*

TRADE PUBLICATIONS

CAMPLEX.—Leaflets describing electric seed propagator and fluorescent fittings for plant irradiation. Simplex Dairy Equipment Co., Cintra Hse, Cambridge.

SIMMS.—Leaflet describing six new products introduced at Commercial Vehicle Exhibition, 1960, by Simms Motor Units Ltd., Oak La, East Finchley, N.2.

MORGANS.—Leaflet TD 23, "Crusilite Tube Furnace." The Morgan Crucible Co., Battersea Church Rd, S.W.11.

CAV.—Technical leaflet describing panel lamps. C.A.V. Ltd., Acton, W.3.

PYRENE.—Sales information on Bulletin No. 5 of the Metal Finishing Division. Pyroclean No. 104 cold soak type cleaner. The Pyrene Co., Metal Finishing Division, Gt. West Rd, Brentford, Middx.

NEGRETTI.—15-page catalogue B21 describing air-operated receivers. Negretti and Zambra, 122 Regent St, W.1.

The 'fridge as furniture

THE refrigerator as a domestic kitchen appliance is not necessarily a fixed concept, as Tricity have shown with their new "Diner-cold" model. Designed expressly for installation in a dining room, this refrigerator resembles a double-door cabinet in elegant sapele wood. It is, however, a Tricity 4·2 cu ft refrigerator encased in highly polished panels of wood, with an ordinary left-hand opening door. Finished in polished polyester coating it looks perfectly natural among other more traditional dining room pieces and is, in fact, an attractive article of furniture itself.

Tricity believe that their new style refrigerator will be welcomed by households where kitchens are not large enough to take a model of so great a capacity. Obviously, this is not its only application and there is no reason why a "dining room refrigerator," as distinct from the kitchen type, should not evolve as an accepted piece of equipment from Tricity's latest idea.

Known as "Diner-cold," the new refrigerator is identical internally to the ordinary 4·2 cu ft, but has attractively designed flaps covering the freezer, fats rack and door compartments, each appropriately labelled. "Diner-cold" has a "Tecumseh" compressor unit, guaranteed for five years. Dimensions: 36 in. high, 22½ in. wide and 25 in. deep. Price £75 12s. *Tricity Cookers, Thorn Hse, Upper St. Martin's La, W.C.2.*

Tricity's "Diner-cold" looks perfectly natural in the dining room. Price £75 12s

equipment for industry

Ionisation-type u.h. vacuum gauge

DEPENDING upon the ionisation current principle a gauge for measurement of ultra high vacuum consists of an Alpert type gauge head, a control unit and an ionisation current amplifier. The gauge head, series IG-3, has a nominal sensitivity of 12·5 mA per micron per mA emission and permits vacuum measurement down to 5 by 10^{-11} torr, which is the soft X-ray limit. The control unit provides stabilised supplies of filament and emission currents electrode potentials and degassing electron bombardment up to 100 W. Signals from the gauge head are amplified and appear as voltages on a chassis-mounted meter. Ionisation current and hence vacuum can be read off from calibration tables. The increasing importance of ultra high vacuum techniques, particularly in the semi-conductor industry, should make this instrument of interest. *Edwards High Vacuum Ltd., Manor Royal, Crawley, Sussex.*

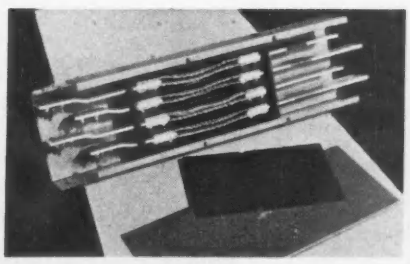
Nylon bush fastener

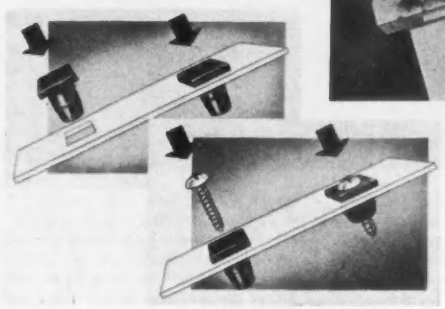
CONSISTING of a moulded nylon bush, used in conjunction with a self-tapping screw, the "Insulgrip" fastener provides an insulated anchorage point for sheet panel. To fix the device the nylon bush is inserted into a square hole cut in the sheet for the purpose, the bush having an undercut square shoulder to prevent rotation. The screw is tapped into the bush and tightened up. The effect is to compress and expand the inserted end of the bush which is thus locked firmly to the panel. A particular advantage of this fixing method is that access to the back of the panel is not necessary. A range of sizes is available for these fasteners, the largest being for a 0·398 in. sq. hole, for which the pull-out force is 900 lb. An alternative type is more heavily insulated and designed for round-hole fixing. Besides its obvious applications in light engineering, the device should be particularly useful in the manufacture of electrical instruments and appliances. *George Goodman Ltd., Robin Hood La, Hall Green, Birmingham, 28.*

Aluminium busbar trunking

RECENTLY introduced is an aluminium busbar-trunking system for industrial installations. The trunking, fabricated in zinc-coated steel, is 7½ in. high by 3½ in. deep and is supplied in 8 ft lengths. The four 2 in. by ¼ in. extruded aluminium alloy busbars are supported at 1 ft intervals, tap-off points being at every 2 ft. Standard tap-off boxes available are for 60 A and incorporate h.b.c. fuses and neutral link which plug directly into the busbars. A special interlock prevents accidental interchanging of the neutral with a fuse link. Entry units consisting of gland and cable sealing box, allow for connection direct to the busbars or via a 400 A TP and N isolator. Jointing of busbar lengths is carried out by means of bolted fishplates, contact surfaces having first been coated with a special compound supplied. For lengths of trunking greater than 100 ft there are expansion units. Known as the "Astralecon" system, advantage claimed by the makers is the saving possible in packing and transport charges due to the compact design and light weight of the components. Basic price of the trunking is £1 6s 9d/ft run. *Astral Switchgear Ltd., Alma Rd, Enfield, Middlesex.*

A comprehensive system of aluminium busbar trunking for factory and commercial installations is now available from Astral Switchgear. Tap-off points from the four, 2 in. by ¼ in. busbars are provided at 2 ft intervals. For lengths exceeding 100 ft, expansion units of the type shown are used





Rigid, insulated fixing to sheet metals is ensured by the "Insulgrip". Driving a screw into the insulated nylon bush causes it to expand and grip the metal mounting plate

Stabilised power supply

CONSTRUCTED as a chassis unit for convenient mounting with other equipment, a recently introduced stabilised power supply provides ±300 V d.c. at 0 to 100 mA, and in addition, an unstabilised 6 A supply at 6·3 V a.c.

Output impedance of this unit is said to be less than 1 ohm, and the ripple to be less than 2 mV. The stabilising unit is 11¼ in. by 9¼ in. by 5⅞ in., high and connections may be made, either by a 6-pin socket on top of the chassis or from solder lugs underneath. *Servomex Controls, Crowborough, Sussex.*

Portable test-meter range

A RANGE of versatile portable instruments for a.c. measurement of current and voltage has recently been introduced into this country from America. This is the "Amprobe" range of which there are a number of models having various ranges, including, for one model, resistance measurement. They are lightweight and compact and can be held easily in the hand by means of a pistol grip. The "clip-on" principle is used for current measurement, trigger operated jaws being snapped round one current-carrying conductor of the circuit to be tested. Voltage measurement is by means of test-prods. A typical model, the RS-1, has five current ranges covering 0 to 100 A while the two voltage ranges are 0 to 150 V and 0 to 600 V. The ranges of these instruments can be further extended by means of two transformer devices. One of these is in the form of a plug-adaptor which enables current readings to be taken from twin-conductor supply leads without having to break the conductor. A useful feature of the standard instrument is the scale-pointer locking device which enables readings to be taken in cramped situations. A range of test kits are available containing various combinations of the equipment described. These should prove invaluable to service engineers. *H. J. Baldwin and Co. Ltd., 221 Grand Bldgs, Trafalgar Sq, W.C.2.*

A feature of the "Amprobe" is the pointer locking device. In addition to 5 current ranges covering 0-100 A, voltage ranges may be measured with the equipment illustrated

Relay with mechanical time delay

TWO relays recently announced incorporate an escapement movement to give a time delay either on opening or closing. Both relays are suitable for either a.c. or d.c. supplies and have consumptions of 25 VA on a.c. and 8 W on d.c. Micro-switches provide the auxiliary contacts, which are of the changeover type, having capacities varying from 10 A, 120 V a.c. to 5 A, 250 V a.c. or 0·1 A, 250 V d.c. These timer relays are claimed to have a repetitive accuracy of 1% and adjustment is provided over the complete timing range by a simple dial. Type R103 is available with three timing ranges of 0 to 10, 0 to 60 and 0 to 300 sec, while type R107 has a range of 0 to 600 sec. Weights of the relays are 1¼ lb and 3¼ lb, respectively, and certain intermediate timing ranges can be supplied if required. *Magnetic Controls Ltd., Maidstone, Kent.*

Epoxide resin price reduction

FROM 1 Oct. prices of all liquid and solid "Epophen" Epoxide Resins were reduced by 1s/pound. Similar reductions have been made on the "Epophen" hardeners. These resins are said to have wide applications in the electrical industry for potting and encapsulation. *Leicester, Lovell and Co. Ltd., North Baddesley, Southampton.*

Improved lifting magnet

BY using modern materials and construction techniques it is claimed that improved performance is obtained with a reduction in price for a new series of lifting magnets. The magnets are in the Burnand Phoenix range and have an "integral" design, the main feature of which is: use of a single high permeability steel casting in place of the separate top and rolled steel outer ring used in earlier designs. Advantages of the new construction is reduction in the amount of machining required with consequent economies. Performance is also assisted by using improved winding insulation, although the vacuum drying and solid impregnation treatment which has been proved over many years will continue to be applied to the new designs. *W. E. Burnand and Sons Ltd., Duo Wks, 66-106 Shoreham St, Sheffield 1.*

Size reduction of silicon diode

A REDUCTION in the size of their 1A silicon junction rectifier has been achieved by AEI Electronic Apparatus Division which makes it more suitable for use in printed circuits. The type SJ Form 'F' silicon rectifier has a flange diameter of 13/32 in. and is intended to replace the Form 'B', whose rating is identical. *AEI Valve and Semiconductor Sales, Carholme Rd, Lincoln.*

GRID FAULT LOCATION

THE problem of locating faults on grid lines is particularly severe in Scotland where harsh winters combine with uneven terrain to make "walking the line" a difficult and time-consuming operation. In the ELECTRICAL TIMES for 3 September, 1959, a description was given of a fault locator operating on the radar pulse principle which had been developed by Ferranti, Edinburgh. The locator was of the d.c. type, requiring connection to the line and, therefore, only suitable for "dead-line" working.

Promise of devising an a.c. locator suitable for "live-line" working, made at that time, has now been fulfilled, and the instrument was demonstrated last week to area board engineers and consultants. Facilities for the demonstration were made available by the SSEB at their Clydes' Mill power station.

The a.c. detector has been developed for use on 132 or 275 kV lines but is said to be suitable for lower or higher system voltages. It is claimed to detect position of arcing faults, ice build-up and conductor oscillations to an accuracy of 1% of the line length or 1,000 yards, whichever is the greater.

The instrument has been designed for simple operation in either manned or unmanned substations and, by making use of the station battery supply, it is rendered independent of errors due to mains voltage fluctuations.

Range of the instrument is said to be from one mile to a maximum of 100 miles, depending on line conditions. The signals are injected into the line through some coupling device which may well be the coupling capacitor of a carrier control system.

The transmitted signal consists of a series of 5 microsecond pulses with a peak-to-peak amplitude of 400 V and at a mean frequency of 1 Mc/s. The injected pulses are spaced at approximately 5 millisecond intervals. All discontinuities on the line cause reflections and it is by measuring the time interval between the transmitted pulse and the received reflection that the distance to a fault is estimated. Reflections are obtained not only from a fault position but also from permanent features such as towers, so that some care in interpreting results is necessary.

An important advantage of the a.c. locator is that, by using it in conjunction with a camera, records can be obtained of transient faults. A Shackman Autocamera is used which automatically resets after taking a photograph so that several faults may be recorded in succession without developing the film. For a transient fault the recording must be obtained between the operation of the first fault relay and opening of the circuit-breaker, an interval usually of the order of 150 milliseconds. After an initial delay of 20 milliseconds to allow transients to subside, the camera photographs the display cathode ray trace, also in about 20 milliseconds. A viewing facility for monitoring and inspection is also provided, and to enable the operator to examine a line in greater detail provision is made for scanning any 15-mile section of the line throughout its length. The display used gives a picture of the permanent features of the line which provides range calibration.

Mr C. L. C. Allan, chief engineer, NSHEB (second from left), and Mr C. Walters, chief technical officer of the SSEB (right), discuss with Ferranti representatives operation of a prototype instrument for locating faults on live h.v transmission lines. Using a pulse reflection principle, the instrument is claimed to locate arcing faults, conductor swinging or ice build-up to within 1% of the line length

PROBLEMS AND PRACTICE

We welcome contributions to this feature; those published will be paid for at our standard rates. There must be many problems encountered in day-to-day electrical work, or useful ideas or tools devised to make it easier; all make instructive reading.

Results of Starter Faults

THE following two cases illustrate how a fault on a motor starter may cause serious inconvenience and, possibly, damage to other parts of an electrical installation.

Equipment in a certain factory included 40 h.p., 18 h.p., 10 h.p., 5 h.p. and 4 h.p. motors, each controlled by a hand-operated starter with overload and undervolt releases. The motors were fed through distribution box fuses protected, in turn, by a combined main switch and fuse. The only automatic protective devices on the installation were the motor starters. After a short period of use it was found that, when the stop button of the starter controlling the 25 h.p. motor was operated, on many occasions the other motor starters tripped as well. No fuses were blown and the motors could be restarted in the usual way afterwards, nor was trouble experienced when the 25 h.p. motor was started or running. In case there might have been supply disturbances, recording voltmeters were temporarily installed, but these revealed nothing unusual.

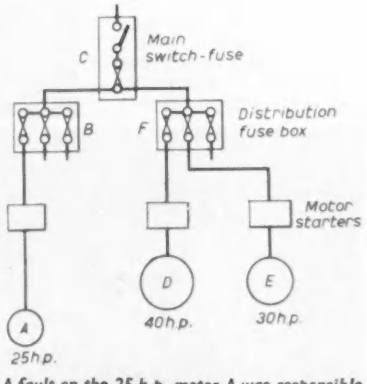
Subsequent investigations revealed a burn mark on the inside of the metal cover to the 25 h.p. starter together with signs of burning on the moving contacts adjacent to them. It was apparent that arcing had occurred between the contacts and the cover, presumably when the starter was tripped.

Apparently, an arc was first drawn out between the fixed and moving contacts which was transferred from the fixed contacts to the earthed cover as the moving contacts passed, under the influence of the controlling spring and their own momentum, beyond dead centre and outside the arc-chutes. The earth fault was enough to momentarily reduce the voltage sufficient to cause instantaneous operation of the undervolt releases on the other starters and to quench the arc without blowing the fuses or overcoming the damping of the voltmeter needle. The remedy was to extend the arc chutes so that the moving contacts remained enshrouded, even on overtravel beyond dead centre.

The second case concerned an installation in which a 25 h.p. conveyor motor, A in the diagram, was controlled by a manual, non-automatic star-delta starter through fuses in a distribution box, B, controlled in turn by a switch-fuse, C. On one occasion the motor could not be started. What is more, nor could the 40 h.p. motor, D, and 30 h.p. motor, E, which were fed through a different distribution box, F, in which all fuses were intact. Examination disclosed badly burned contacts in the 25 h.p. starter, so bad in fact that single phasing occurred in both starting and running positions. It seemed evident that the starter must have been running in the single-phase condition for some time since the cables between the starter and motor were overheated and had an earth fault, necessitating renewal. As a result, one of the heavier rated fuses in distribution box, B, had gone together with one in main switch, C. Naturally, the other two motors could not be started. Although the individual motor fuses in distribution box, F, were intact, one rotor starting resistance for the 40 h.p. slip-ring motor had also failed.

The occurrence stressed the importance of regular maintenance and inspection of starters and ancillary gear as well as the correct grading of fuses in main and sub-distribution boards. It also illustrated the danger of allowing a motor to remain stalled with current switched on. In this case the 25 h.p. motor could not be seen from the starter position and the operator had no means of knowing whether or not the motor was running. An ammeter was installed by the starter and the operator instructed to hold the handle in the starting position until the ammeter needle indicated that the current had fallen to a steady value before moving over to the running position. He was also warned to switch off if the current did not quickly settle down to the full-load value.

The incident would not, of course, have occurred had the starter been of the "free-handle" type with overload protection.—*J. L. Watts.*



A fault on the 25 h.p. motor A was responsible for fuses in C blowing, thereby affecting motors D and E. For clarity the diagram is shown in single line; fuses and cables are, of course, 3-phase

Tungsten Ballasts

"IT makes me wonder," says Mr Ralph (page 453, 22 Sept.), "why the tungsten filament ballast should ever have been considered a commercial proposition." The simple answer is, of course, that it is. Not, one hastens to add, where a purely fluorescent installation would be satisfactory, but in those cases—shop lighting immediately springs to mind—where a combination of fluorescent and tungsten filament is ideal. Whenever one-third or a higher proportion of the total light is required from filament lamps, the filament lamp ballast is likely to give a cheaper and lighter installation with similar consumption. Take a hypothetical case. Suppose we require about 100,000 lumens from de-luxe fluorescent tubes and the same amount from tungsten filament lighting. The outputs and consumptions of two possible systems would be:

Scheme A.	30- 80 W tubes	96,000 lm.	2·4 kW
	30 ballasts		0·45 kW
	90-100 W spots	97,200 lm.	9·00 kW
	TOTAL	193,200 lm.	11·85 kW
Scheme B.	65- 40 W tubes	96,200 lm.	2·6 kW
	65- 75 W lamps	48,295 lm.	4·87 kW
	46-100 W spots	49,680 lm.	4·6 kW
	TOTAL	194,175 lm.	12·07 kW

In fact, being realistic about the accuracy to which we know the quantities involved, we can say that the outputs and consumptions are the same.

Of course, tube life is shorter, though the reverse is true of the ballast lamps, and in particular instances there may be good reasons for using only inductive ballasts. What can be said, however, is that there is often a good case for using all or part of the filament side of a mixed installation to control all or part of the fluorescent.—*J. Boud.*

Mr McNeill Replies

May I reply to Mr Boud? With regard to the two schemes compared, it is interesting to note that in both cases the tungsten filament lamp watts are more than three times that of the fluorescent lighting. This tends to swamp the relative efficiency factors of the fluorescent lighting sections alone. It should also be noted that the ballast lamp circuit is normally limited to use with 4 ft 40 W tubes, whereas 5 ft 80 W and 8 ft 125 W tubes are almost invariably more suitable for high level lighting in modern store interiors.

The most important factor appears to

be in deciding the proportion of filament lighting required to supplement the general fluorescent lighting. In the case of fluorescent tube plus ballast lamp, a 75 W ballast lamp must be used with every 4 ft 40 W tube, so taking nearly twice as much filament lamp watts as fluorescent. In practice, it is often desirable to vary the proportion of filament to fluorescent lighting in different parts of a store interior since, in certain locations—such as over jewellery displays—an all-filament lamp scheme may be preferable, while in other general display areas an all-fluorescent installation may be adequate.

In the average location, however, it is normally desirable to supplement the general fluorescent lighting with a few tungsten filament spotlights to give a varied and more interesting brightness pattern and to accentuate specific display features. For this type of display area the use of one 50 W low voltage spotlight per twin 5 ft 80 W fluorescent tube fitting will normally give a reasonable balance. It is also found that the concentrated beam provided by low voltage filament lamp spotlights is ideally suited for high-lighting individual display features with the minimum of spill, so creating a more dramatic effect against the lower illuminated background.

A further factor which has reduced the need for a high proportion of supplementary lighting has been the development of fluorescent tubes in which the red colour rendering is at least equal to that of filament lamps.

Provided, therefore, that fluorescent tubes with good all round colour rendering properties, such as de-luxe Natural, are used, a scheme comprising 32-50 W, 12 V spotlights, in conjunction with 32 twin tube 5 ft 80 W louvred store lighting fittings will provide a total light output of 194,400 lumens with colour rendering quality and accent lighting adequate for store applications.

The kilowatt loading and costs associated with this arrangement (scheme C) are detailed in the following table, together with schemes A and B in Mr Boud's letter for comparison, allowing for comparable twin tube louvred store lighting fittings and narrow beam spotlights in each case and taking the cost of electricity as 1½d per unit.

Scheme	A	B	C
kW load	11·85	12·075	7·84
Initial Cost	£684	£528	£881
Running Cost			
Current	£222	£226	£147
Replacements	£116	£91	£67

Comparing the ballast lamp scheme B with scheme C, it will be seen that the difference in initial cost of fittings amounts to £353, whereas the cost of current consumed in the two schemes over a period of 3,000 hrs, that is, one year of normal average use, shows a difference of £79 per annum in favour of C. This scheme also shows a further saving of £24 per annum on lamp and tube replacement costs. Assuming an average fitting life of ten years, the total extra cost of electricity and lamp replacements in scheme B is about £1,030 more than for scheme C, nearly three times the difference in initial cost of £353.—*G. V. McNeill.*

[*Mr Boud and Mr McNeill make their points with admirable clarity. The hypothetical case rarely corresponds to the practical one however and each installation has to be planned to meet the requirements of the situation. Each is a compromise between the ideal of initial cost, running cost and ultimate lighting effect. It is for the user to decide in which respect he is best able to make a sacrifice. To some, capital outlay is of more importance than running cost; to others, it is the reverse. In the odd case, lighting effect is all important and to blazes with initial and running costs. The task of the lighting engineer is to strike the most acceptable balance between all three and this he does with consistent success, often depending more on his experience than on the many coefficients and factors which feature in illumination textbooks. These columns are enriched by such discussions. We would like to see more of them.*]

Control Circuit Query

IN regard to Mr F. d'Abila's letter on control circuit protection, in the 8 Sept. issue, would not the insertion of a suitable resistance in the e.h.t. circuit to limit any fault current obviate the necessity of the protective circuit suggested?—*W. Thompson.*

Floodlighting effects at Little Barford "B"

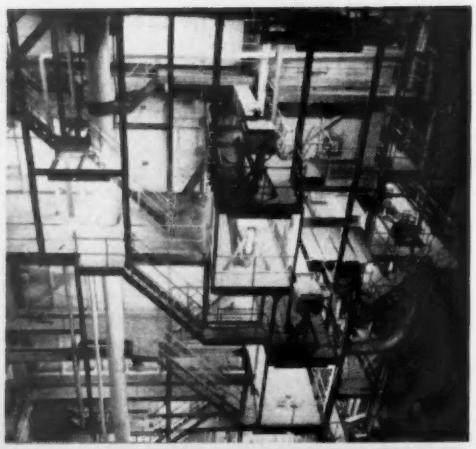
TO the casual observer, the most impressive feature of Little Barford "B" generating station is the pair of external boiler structures which, at night, have the appearance of being floodlit.

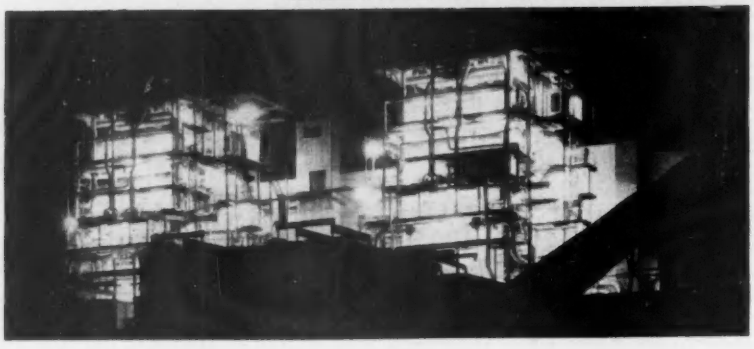
Actually, floodlighting fittings have not been used. The normal nighttime lighting for engineers and staff has been so arranged that none of the light from the 5 ft 80 W weather-resistant fluorescent lighting fittings falls outwards from the structure, excepting only in one or two places where not to have done so would have introduced hazardous conditions. Over 100 fittings are installed in these areas.

In the turbine hall, 16 1-kW h.p.m. fluorescent lamps in reflector fittings mounted high in the roof provide an overall illumination of 10 lumens/sq ft on the operating floor. In the basement, tubular fluorescent lighting gives additional illumination.

Fluorescent lighting above an "Ionlite Series 1" suspended illuminated ceiling provides the normal light in the control room. For emergencies, four recessed decorative tungsten fittings have been incorporated.

All of the lighting units were supplied from their standard range by Falks, whose engineers worked in close collaboration with the architects, electrical and illuminating engineers and officers and staff of the Board throughout.





General view of the outdoor boiler structure at Little Barford "B" power station with, below, the distent floodlight effect achievad

News of the Week

JOHN THOMPSON TO MAKE COOKERS

Link with U.S. Concern

JOHN THOMPSON (WOLVERHAMPTON) LTD., the boiler-making and heavy engineering group, is moving into the domestic appliance field. It is understood that an agreement has been concluded between a subsidiary, John Thompson Instrument Co., and the Tappan Company of Mansfield, Ohio, under which electric cookers of the Tappan series will be produced at Wolverhampton.

Details of the project will be revealed at a meeting in London on 25 Oct., but it is believed that the cookers, which are in the luxury class, will be marketed in the UK under the name "Thompson-Tappan." In America the Tappan Co. produce various types of ranges—electric, gas and electronic—in free-standing and built-in styles, with all the latest gadgets, including broilers and eye-level control panels.

Earlier this month, John Thompson announced their intention to extend their industrial refrigeration manufacturing activities from South Africa to the UK. Domestic refrigerators and retailing equipment were specifically excluded in the announcement of that plan.

Radio Rentals buy "Baird"

"BAIRD," name of the inventor of television will, in future, be the brand name of Radio Rentals Ltd.'s television and radio sets. Announcing this last week, Mr P. Perring-Thoms, founder and chairman, said his company had purchased Baird Television Ltd. Acquisition of the "Baird" name appears to have been an important factor in negotiations. Price of the deal was not disclosed. Hitherto, sets rented by Radio Rentals have borne the symbol "RR" and those sold outright "MRG," standing for Mains Radio Gramophones, the subsidiary which manufactures both radio and television receivers at Bradford. In the past six months, Radio Rentals has been selling its products to the trade as well as direct to the public through its own nation-wide organisation.

Mr Perring-Thoms is now in Australia visiting a "rent or buy" subsidiary there. He left by air, via the US, immediately following the announcement of the Baird deal.

Transmission group move

THE Transmission Project Group of the CEGB, under Mr H. R. Schofield, will move from London to Stockland Hse, Portsmouth Rd, Guildford, early in the new year. The Board have taken a 99-year lease of the premises, we understand.

VACTRIC STOPS WASHING MACHINE PRODUCTION

FIRST announcement by the newly appointed receiver and manager of Vactric Ltd., Mr J. W. Margetts, is the suspension of production by the washing machine subsidiary, Vactric (Manufacturing), which is being put into creditors' voluntary liquidation.

However, Vactric may get a bid from Longford Electric Co. of Manchester. Longford is understood to be seeking additional factory premises to meet increasing demand for its spin-dry washing machines.

£1¼ m. cable contract

THE Renfrew factory of Scottish Cables Ltd., a member of the BICC Group, has just obtained its biggest contract. The order is for £1¼ million worth of paper- and plastics-insulated underground cables to be supplied in 1961 to the South of Scotland Electricity Board for the distribution of electricity.

Boards' appliance sales

STEADY improvement in washing-machine sales is one feature of the latest return of domestic-appliance sales by electricity boards in England and Wales. The total of such sales in August—7,780—was just over 700 more than in the previous month and nearly 1,000 more than in June. Sales of cookers, also, have been well maintained but refrigerators sagged off badly in the poor weather of August, reaching only 9,154, the lowest month's figure since last February. That total compares with 16,425 in July and 29,833 in the month of June last.

Appliances Sales by Area Boards	Sales in month ended 31 Aug., 1960		Sales in 12 months ended 31 Aug., 1960	
	Total	% change over Aug. 1959	Total	% change over previous 12 months
Cookers ...	26,429	+ 1·3	339,121	+ 3·2
Water Heaters:				
Immersion	16,642	− 9·1	190,546	+ 1·5
Storage ...	5,176	+17·6	67,571	+17·0
Washboilers	4,537	−19·7	59,880	−18·0
Washing Machines ...	7,780	−42·3	133,797	−17·2
Refrigerators	9,154	−48·5	146,805	− 6·5

When assessing the figures given above it must be borne in mind that the sales by area boards represent only a part of the total sales throughout the country.

NEW FACTORY PLANS

For Associated Transistors . . .

A NEW factory for Associated Transistors Ltd. is to be erected on an 18-acre site recently acquired at Basingstoke. The first phase of construction will cover 120,000 sq ft and building work started last week. Planning of the second phase is well advanced. By 1963, annual output should be about 15 million transistors. Initially, there will be about 1,000 employees. Associated Transistors was formed in 1958 jointly by Automatic Telephone and Electric Co., English Electric Co. and Ericsson Telephones Ltd.

. . . Belling's extension

A NEW extension of Belling and Co. Ltd., at Enfield, now nearing completion, and a further extension there on which work is soon to start, will provide another 100,000 sq ft of productive space. At Burnley, a further 100,000 sq ft of capacity should be in use early next year. Yet despite this large increase in output, the firm is still unable to meet the demand, particularly for heaters, we understand. Sales figures a few weeks ago were about 20% up on 1959, but the recent wintry weather has sent the demand rocketing.

. . . and for Plessey

PLANS for another factory in Hampshire, near Titchfield, on the London-Southampton road, are being prepared by the Plessey Co. That firm is finalising negotiations for the purchase of the old 66-acre RAF balloon barrage station, Southampton, where it is proposed to manufacture components for a wide range of industries, with an initial labour force of over 600. Because the site is not zoned for industrial purposes the application for planning has to be referred to the Ministry of Housing and Local Government, but it is hoped to start production before the end of 1961.

Although believed to be the largest load yet to travel on the M1 motorway, this 125-ton transformer broke no speed records on its journey from the AEI Rugby Works to the CEGB Midlands Division substation at Feckenham, Worcs. The 94-mile journey took approximately three days. The 120 MVA transformer is the first of two being supplied to Feckenham

More trouble at Hunterston

ONCE again labour difficulties have arisen on work of building the Hunterston nuclear power station for the South of Scotland Electricity Board, and once again the welders are involved. On Thursday last, 260 welders working there gave seven days' notice of termination of their employment. This followed the employers'—the Motherwell Bridge and Engineering Co.—refusal to reinstate nine welders who were dismissed on 7 Oct. Then, the other welders claimed they had been wrongfully dismissed and demanded their reinstatement. Talks between representatives of the Boilermakers' Society and the firm ended in deadlock last week and the 260 welders handed in their notices.

According to the West of Scotland delegate to the Boilermakers' Society, the nine welders were told to do certain work begun by other welders whose work had been declared below the required standard. The nine men wanted an assurance that they would not be held responsible for any faults which were there before they took over the job. This assurance was refused, he maintained, so they would not undertake the work and were dismissed.

It will be recalled that the Motherwell Bridge and Engineering Co., who are responsible for the main constructional work at the station, suspended work on their contract for 15 weeks between Sept., 1959, and Jan., 1960, and dismissed 500 men on the site because of recurring strikes. Work restarted in January after a new wages structure had been approved by the unions involved—the welders being the last group to accept it.

Supply for Borrowdale

THE plan to supply electricity to hamlets and dwellings at the head of the Borrowdale Valley is now being finalised, it was stated at the recent meeting of the Lake District Planning Board. The North Western Electricity Board have offered to lay the line to Borrowdale underground where there is no tree cover and the supply to Seathwaite will be taken by means of a p.v.c. cable from Seatoller through Low Stile Wood. Supply to Stonethwaite will be by a normal type of o.h. line sited on the fell side in a position to be approved by the planning board and the National Parks Commission. But the latter two concerns want that section also placed underground.

Fire Precautions for Factories

FIRE alarms will be required in about 10,000 more factories than at present when some provisions of the Factories Act, 1959, comes into force next December. The statutory instrument naming 1 Dec., 1960, as the day was published last week. Also brought into effect then will be detailed fire protection requirements of the Act, affecting provision of fire-fighting equipment. Under the new provisions, fire brigade officers will be associated with factory inspectors in checking on the fire precautions in factories. The Chief Inspector of Factories has stated his intention of sending a letter to all factory occupiers, drawing their attention to the new requirements and advising them in particular on fire-fighting equipment and alarms.

Skilled Labour Still Short

DESPITE the credit squeeze, shortage of skilled labour was still expected by industrialists, a fortnight ago, to be the greatest limitation to production in the next four months. When the Federation of British Industries quizzed 728 manufacturers at the end of September, 30% thought skilled labour shortages would be the main curb on their output, while shortage of orders or sales was next in importance with 22%.

The survey showed a shading off in optimism about the general business situation, but expectations of capital expenditure in the next 12 months did not alter radically. Building expenditure was expected to decline by a greater proportion of industrialists than at the last survey, but plant and machinery showed an opposite trend. Excluding seasonal factors, 57% said they were working at full capacity.

Rising output was indicated by 40% of those questioned, against 10% who said it was falling, but 37% said profit margins per unit had fallen, with costs showing an upward trend.

Radio remains popular

SOUND radio is not waning in popularity, latest figures of the Radio and Television Retailers' Association show. While television sales have fallen sharply in the face of hire-purchase restrictions, radio sales have actually moved ahead. Average sales of 16 radio sets per shop during August compares with 15 a year earlier; comparable figures for television show a drop from eight to 5·5 sets per shop. But the lower price of radio makes it less vulnerable to hire-purchase curbs. While the percentage of television sets sold on hire-purchase dropped from 58·2% in August, 1959, to 45·6% in August this year, the fall was only from 40·4% to 34·3% in the case of radio.

Television sales rose by 1·5 sets per shop from July to August this year, but failed to match the seasonal uptrend usually evident in that month.

OFFICIAL PUBLICATIONS

NJAC for Electricity Supply Industry 1959-60 Report (see page 604).

Advisory Committee on Examination of Steam Boilers in Industry. HMSO. 1s 3d (see page 590).

Council for the Preservation of Rural England. Report for 1959-60. (see ELECTRICAL TIMES, 28 July, 1960).

Factories Act, 1959 (Commencement No. 4) Order, 1960. S.I. No. 1839. HMSO. 2d (see page 618).

Factories (Fire Certificate Application) Order, 1960. S.I. No. 1840. HMSO. 3d (see page 618).

ERA Publications:

D/T112. Intrinsically Safe Electrical Apparatus. Relation of Igniting Current to Circuit Inductance for a Mixture of Buta-1:3-diene with Air, P. B. Smith and N. L. Heathcote (4s 6d); D/T113. Intrinsically Safe Electrical Apparatus. Relation of Igniting Current to Circuit Inductance for a Mixture of Carbon Disulphide Vapour with Air, P. B. Smith and N. L. Heathcote (6s); D/T114. Flameproof Enclosures: Effect of Internal Pressure on the Flange Gap Width at the Time of Ignition of an External Mixture, T. J. A. Brown and N. Simpson (15s); G/T312. Restriking Voltage 33 kV Survey—East Cornwall Network, J. S. Vosper (10s 6d); N/T86. Effect of Temperatures of 650°C and 700°C on the Magnetisation and Properties of Alcomax Magnets, A. G. Clegg and M. McCaig (4s 6d); S/T97. Line and Neutral Currents in Multi-Limb Transformers under Impulse-Test Conditions, E. L. White (15s).

Organisation of Electric Power Services in Europe (second edition). UN Report. 5s.

Two Bids For Elizabethan

TWO firms are interested in buying the washing machine manufacturing business at Bishop's Stortford of Elizabethan Engineering Co. Ltd. and its subsidiary, Elizabethan Dynamatic Ltd. (whose voluntary liquidation we referred to on 15 September). Both Elizabethan companies are in liquidation with a combined deficiency of about £241,000, including £50,000 paid capital. Assets total about £79,000. The takeover approaches were disclosed by Mr H. E. Hassell, joint liquidator, at a creditors' meeting in London on 12 October.

The value of the offers and the names of the bidders were not disclosed. Without this information, creditors were not in a position to decide on a proposal of the managing director of both the Elizabethan companies (Mr J. Morgan) that the Elizabethan enterprise should be carried on by the present directors under the surveillance of an Inspection Committee appointed by creditors. Creditors appointed the Inspection Committee, but decided to take no further action until they had been advised by the liquidators.

An important factor in creditors' deliberations is a contingent claim of £98,000 by hire purchase companies if service facilities for Dynamatic washing machines should be discontinued. One of the potential purchasers has already stated that they would maintain service facilities if their bid were accepted.

Each of the three directors of Elizabethan Engineering, Messrs J. Morgan, J. Boniface and L. J. Foley, is involved in a personal guarantee against liabilities.

STUDY ON STATIC

AN investigation of the cause of the generation of static electricity in synthetic fibres is being carried out at the British Cotton Industry Research Association headquarters at Shirley Institute, Manchester. This was announced by Dr D. W. Hill, director of the Institute, at the annual meeting of the Association last Thursday.

Retail Sales Steady

RETAIL sales were maintained in September at about the same level as during the past six months, allowing for seasonal differences, according to an estimate by the Board of Trade. Compared with a year earlier, sales in September were up by 2% to 3% in volume after adjusting for a 1% rise in prices during the year. The Board of Trade says there are indications that clothing and footwear sales were very buoyant last month, but durable goods probably failed to show any rise.

Switchgear for Kuwait

AN order for switchgear valued at £156,000 has been placed with South Wales Switchgear Ltd. by the Government of Kuwait. The contract is for 500 MVA 11 kV type switchgear for three main substations. For each of two substations at Hawalli and Naif Gate, the equipment includes a 21-panel duplicate-busbar air-insulated switchboard, incorporating solenoid-operated circuit-breakers of up to 1,600 A ratings.

The third substation—at Kuwait Airport—will have the same equipment on a smaller scale.

Refrigerator Production

DURING his tour of the Morphy-Richards' Dundee factories last week, Sir Joseph Lockwood, chairman of Electric and Musical Industries, which recently acquired control of the business, said they hoped to carry out further extensions at the Astral subsidiary. Later, Mr W. Roxburgh, managing director of Morphy-Richards (Astral) Ltd., intimated that they were planning to transfer the whole of the refrigerator production to the new factory being built at West Kingway and to introduce new products to the Longtown factory, which would probably raise the number of employees from 1,250 to about 1,500.

B.S.R. Cut Production

ABOUT 980 employees are likely to be made redundant at the Londonderry works of Birmingham Sound Reproducers Ltd. as the result of the company's decision to cut production. Dr D. M. McDonald, chairman, last week stated that this step was due to the rising costs in Northern Ireland, not least among which are the freight rates to British ports. He emphasised that the export business to the United States had become increasingly competitive and the company did not intend to lose any of it. Emphasising the value of such business, he said the export value of sales in the US during 1959 was nearly $1 million greater than the sale of all British bicycles to the US in that year.

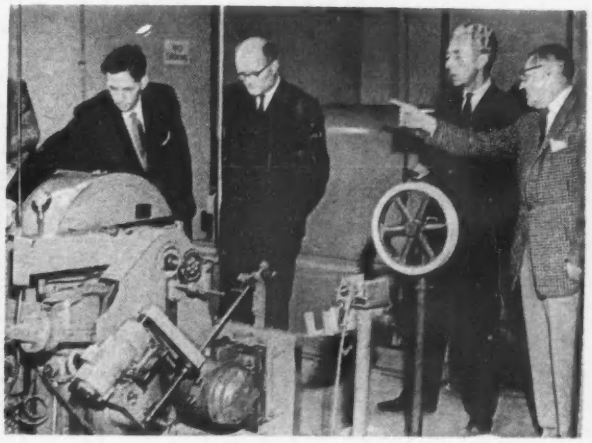
Another Dishwasher

YET another domestic dishwashing machine is about to be launched on the market—this time an "electronic" model costing 60 gn. It has fully automatic push-button control and the firm, Halpins (Dishtron) Ltd., 57-61 London Rd, Southampton, claim that it will deal with a complete dinner service and dishes, including rinsing and drying. Expected to be available within three months the machine will probably be supplied direct to retailers, we understand.

Civils and Municipals to amalgamate

AMALGAMATION of the Institution of Civil Engineers and the Institution of Municipal Engineers is proposed. Terms of the amalgamation have been agreed by both Councils and are now being circulated to the 17,000 corporate members of the Civils and the 6,000 members of the Municipals, who are asked to decide. The latter Institution (which was formed in 1873) will be absorbed in the Civils (formed in 1818) and become a special branch therein.

Outlining the principles of the plan, Sir Herbert Manzoni, president of the Civils, reveals that during the past four years the Council of the Institution have had under constant review the reunification of the profession which has suffered much from "fragmentation" or "splinter" groups in the past and new organisations of specialist groups are continually being formed. The ICE Council believes that engineering is one profession which covers all the specialist branches. "The ultimate aim should be that of one society of professional engineers whose corporate members should be chartered engineers," he adds.



Lord Glentoran, Minister of Commerce for N. Ireland, recently visited the Dunmurry factory of Wandleside Warren Wire Co. He was escorted round by the managing director, W. L. Wray (seen on right). Also seen are the Minister's private secretary, Mr A. McCullough, and the factory manager, Mr R. M. Gibson

Automatic Shunting on District Line

AS part of modernisation of signalling and shunting on the Earls Court/Putney Bridge section of the District Line, London Transport is now installing electrically operated "programme machines" at Putney Bridge Station to control signals and junctions automatically. First stage of the project was completed earlier this month, when a battery of programme machines went into action at Parsons Green. The new machines are an improved version of machines installed two years ago on the Northern Line and at Watford. For the first time, trains are identified by their numbers, which are punched into the programme rolls used in the machines.

An additional innovation was required at Parsons Green to permit flexibility in the programme on the rolls. At Parsons Green, shunting is complicated by the ten sidings being located on either side of the two main tracks and at both ends of the station; this means that trains going to sidings sometimes move on the main tracks. Without some flexibility, chaos might result if a siding train arrived late or early. The programme machine would still set the points in the order in which trains should have arrived. The problem has been overcome by introducing an additional programme machine, making four in the battery. By a highly complicated process, this machine is automatically scanned by No. 3, which in turn reacts upon the others to produce the right switching for the siding train, out of turn.

In an emergency, trains may be switched by push-button from a new supervision room at Earls Court.

Supervision of Industry Needed—Citrine

WITH the big, privately owned organisations approaching complete monopoly there must be some stimulus to public supervision and even public ownership, Lord Citrine said at Newton Abbot last week, when he delivered the George Johnstone lecture. In groping for a solution to the problem, Lord Citrine said his feeling was that something in line with the Iron and Steel Board type of organisation might be a solution.

The George Johnstone lecture is sponsored annually by the SW Electricity Board and the Seale Hayne Agricultural College, Newton Abbot.

Welding Standardisation

THE first conference on welding standardisation is to be held by the Institute of Welding on 7 Dec. at 54 Prince's Gate, S.W.7. The theme will be the role of welding standardisation in production and export, among the subjects for discussion being the specifications for steels, and standards for welded structure. The conference is open to individual corporate members and nominees of industrial corporate members.

No Complaints About Estimated Accounts

IT was too early to say whether the experiment with estimated accounts in Surrey Suburban District last quarter had been successful, but no complaints had been received so far, last week's meeting of the London Electricity Consultative Council was told. Opinion of the Council was divided on the proposal for estimated accounts, aimed at cutting costs by reducing the number of readings from four to three each year. However, the meeting made no recommendations to the LEB about the plan.

Turning to publicity, the Council decided to ask the Electrical Development Association to find a name for the "little boy" symbol which has been used on electricity posters and pamphlets in recent years. "Willie Watt" was mentioned as a possibility by Sir Laurence Watkinson, who was in the chair for the first time.

CONVENTIONS

Refrigeration . . .

A TECHNICAL convention will be held simultaneously with the second International Refrigeration and Air-conditioning Exhibition in London next April. The programme is now being prepared by a committee of specialists under the chairmanship of Dr J. C. Fidler, who is chairman of the technical board of the International Institute of Refrigeration.

. . . S.I.M.A.

PRODUCTIVITY will be the main theme at the ninth convention of the Scientific Instrument Manufacturers' Association, to be held at Eastbourne from 17 to 20 Nov. Four panels of qualified speakers will cover most aspects of the subject—design, management, floor production and sales. Among the speakers will be Mr A. H. Willoughby, technical manager, GEC Osram Lamp Division; Mr C. H. Starr, chief engineer, AEI Central Engineering Services; and Mr R. H. S. Lesser (Philips). A Sales Panel under the chairmanship of Mr D. A. Pitman of Electronic Instruments Ltd. will have Mr R. J. Finlayson, operational research manager, Hawker Siddeley Industries Ltd., Mr F. S. Davis, of Marconi Wireless Telegraph Co., and two other speakers.

. . . and Semiconductors

FOR the International Symposium on Semiconductor Devices to be held in Paris from 20-25 Feb. next, the organising committee have extended, until 30 Nov., the date by which participants are to send a summary of their papers. The entire text of the papers must be submitted by 31 Dec. next.

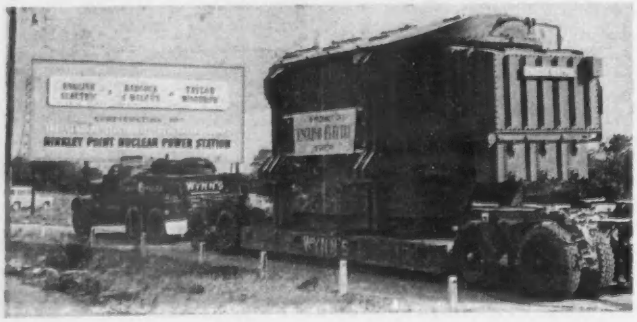
ROYAL OPENING FOR KINCARDINE

CONGRATULATIONS on the station design and facilities for employees' welfare were offered by the Queen when Her Majesty officially opened the Kincardine-on-Forth 760 MW generating station of the SSEB on Wednesday of last week. A large audience had assembled in the station canteen to witness the unveiling by Her Majesty of a commemorative plaque.

On arrival at the station the Queen and the Duke of Edinburgh were presented to Mr J. A. Little, Q.C., and the chairman of the SSEB, Sir John Pickles. After the ceremony Her Majesty was conducted round the station by the superintendent, Mr G. Nicholson, and the Duke was accompanied by Mr John Henderson, chief engineer of the Board.

In welcoming the Queen, Sir John Pickles referred to the importance of Kincardine for meeting the growing electricity demands in Scotland and mentioned that ash from the station will help to reclaim agricultural land from the Forth of more than twice the acreage occupied by the station.

After leaving the station the Queen and the Duke visited one of the Board's new houses occupied by a mechanical fitter, Mr Marr, and his wife. The 92 houses built by the Board are all-electric with floor-warming installations and the station has itself an off-peak floor-warming load of 864 kW. Other features of the station were described in ELECTRICAL TIMES for 13 Oct.



First of six 110 MVA transformers being supplied by English Electric Co. arriving at Hinkley Point nuclear power station

Hinton on Radiation Safety

IN normal operation of nuclear power stations, the only hazards of radioactivity were those arising from gamma activity and neutron activity, suggested Sir Christopher Hinton in a paper before the TUC conference on radiation in industry last week. The plant could be designed so that operators were protected from these and other sources of radiation under normal operation, he said. There was always the possibility of abnormal conditions, as when a fuel can fractures while being removed from the reactor. Then the plant would have to be cleaned. This risk must be understood by the employee and accepted as a reasonable one, where every wise precauton has been taken to keep it under control. Each employee must feel that he can escape from the risk by the exercise of physical or mental skill. To this end, proper training was required.

G.E.C. Gets Traction Order

GENERAL Electric Co. has started work on a £580,000 order from the BTC for the electrical equipment for 23 trains capable of 90 m.p.h. The trains, of which 15 are four-car and eight two-car types, will run between Liverpool St and Clacton or Walton.

SAVING LONDON'S FEET

WE are informed by Alliance Electrical Co. that they were responsible for the relatively large and unusual electrical installation work connected with the Travolator at Southern Railway Bank Station (ELECTRICAL TIMES, 6 Oct.), including the lighting of the Travolator itself and associated lighting work in the platform, booking hall and subways. They were also concerned with the final design of the lighting fittings.

Sayings OF THE WEEK

"At one time company directors used to turn to the obituaries column in 'The Times' to find out whether they were alive or dead. Nowadays they turn to the City page, after they have been away, to find out which company they are working for." . . . MR W. J. BIRD, of GEC, at the Electrical Engineers' Exhibition dinner.

"A year's subscription to 'Which?' certainly saved me money, but it converted me from a happy spendthrift into a suspicious misanthrope." . . . MARK BOURNE, writing to *The Guardian*.

"The coal comes in roughly in the middle and is so dealt with that all the electricity comes out at the west, and all the smoke, ash and other waste comes out at the east." . . . PATRICK NUTTGENS, writing on the Kincardine power station in *The Scotsman*.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, October 18

	£ per ton	Weekly change £
COPPER, standard class A (settlement)	222½	−4
" (3 months)	224	−4
LEAD, refined pig, 99·97% purity (cash)	67½	+⅞
" (3 months)	68⅜	+⅞
TIN, refined, min. 99·75% purity (settlement)	809	−2
" (3 months)	798	−3½
ALUMINIUM, ingots 99·99·5%	186	—
" wire bars (4×4×54")	193½	—
BRASS Strip 63/37	200½	—
SILVER (Troy oz)	79½d	—
ZINC, virgin, min. 98% purity (cash)	87½	−½
" (3 months)	86½	−2
RUBBER, per lb		
No. 1, RSS, spot	29d	+⅛d
c.i.f. basis, ports, Dec.	27⅛d	−⅛d
ARMOURING:		
Galv. Steel Wire (0·104 in.)	66½	—
Mild Steel Tape (0·04 × 1½ in.)	53*	—
NICKEL (home)	600	—
MERCURY (76 lb flask)	70	—
AMERICAN PRICES:		
Copper, electrolytic (per lb)	30c	−1c
Lead, (New York)	12c	—

* *Tape Price, now an average, includes varnishing*

SEMICONDUCTOR LABORATORIES REORGANISED

SEVENTEEN months ago the completion of the second section of Mullard's Southampton semiconductor factory was reported in these pages (p. 730, 7 May, 1959). Since that date a further 30,000 sq ft of administration and factory space has been added, the canteen area has been doubled and the staff increased from 1,000 to over 2,000. Production, doubled from 1958 in 1959, looks like being redoubled in 1960 and a further 95,000 sq ft of floor area is under construction and scheduled for completion in March of next year

The expansion of the production and research activities has necessitated a reorganisation of the laboratory personnel into six separate project groups which, though interdependent in some respects, will each explore a different field of semiconductor application. Under the over-riding control of Mr E. Wolfendale, head of the laboratories, will be two main sections dealing with development assistance and device evaluation by the one and circuit development and consultant service by the other.

The former will be subdivided into electrical development (J. A. Ingham) and device investigation (M. E. Cooke); the latter into power and industrial control (J. H. Tuley), telecommunications and general industrial (A. J. Rees), computers and industrial switching (A. F. Newall) and radio and television (L. E. Jansson).

This point of sale crowner, in four colours, is now available for the Parkinson Cowan "Mayhurst" fan heater

L.E.B. at Willesden show

FOURTEEN manufacturers participated in the exhibition and continuous demonstration of cooking, water heating, clothes and dishwashing equipment in the marquee of the London Electricity Board at the annual Willesden show last month. A feature of this year's exhibition was the information stand in a garden setting, where a "Publiphone" system enabled anyone interested to dial a number on the telephone and obtain information, both from the Board and individual manufacturers, on electrical equipment.

News in Brief

Incidental music accompanied a short film of the manufacture of "Netabulbs" at the AEI works, which was shown on BBC TV programme "Tonight" last Friday.

In the electric-warming system for part of the Hanger La underpass, to which we referred on 29 Sept., a total of 144 "Ashatherm" cables, each of 613 ft, were used, we are now informed by Aerialite Ltd.

Annual dinner of the Midlands branch of the ETCTA will be held on 28 Oct. at the County Ground, Edgbaston. Tickets are obtainable from J. T. Aitken, 27 Hobart Dr, Walsall.

The EIBA has received a legacy of £100 from the estate of the late Mr H. F. Gill, of Purley, for many years honorary secretary of the Surrey and West Kent branch.

Midlothian County Council Finance Committee has agreed that the new Dalkeith secondary school shall be electrically heated.

Company Activities

GENERALLY rather dull with bright intervals, as the "met" office might say. Despite a certain amount of buoyancy from optimists hoping for an early easing of the squeeze, markets got off to a hesitant start. BMC's mid-week announcement of extensive short-time working, coupled with similar news from Rover, seemed to confirm the prophets of gloom and, with an unchanged Bank rate, indices began to wear a distinctly worried look.

Occasionally there was a glimpse of blue between the clouds. Among electricals, too, the Chancellor's squeeze was making itself felt. Vactric holders woke to a Monday morning shock. On the appointment of a receiver and manager, the Ordinaries crashed nearly 6s to 7s 7½d and the "A" just under 4s to 7s 1½d. After a few days vacillation as "bears" covered themselves, the "A" had relapsed to 6s 3d.

Just as the motor cuts indirectly punctured the price of Dunlop, so Vactric's decline brought reactions in Arusha Industries, which had bid for them at 55s, and Lombard Banking owners of a former Vactric hire purchase subsidiary.

Another outstanding feature was the rise and fall of Crabtree. Galvanised by grapevine gossip, and ignoring official take-over denials, the shares climbed to 39s 6d before yet another denial brought them back to earth at 34s 6d. Meanwhile another merger favourite, E. K. Cole, was pushed up to 29s and Dimplex gained 2s 3d to hit a 48s peak.

But in spite of a sharp recovery in profits and a bumped-up dividend, J. and F. Stone, whose year ended on 30 June, lost a few pence. And the "minus" sign went against most of the leaders including EMI, down 1s 6d to 46s, Philips and GEC, who shed 2s 9d to 35s 9d. AEI, Crompton, English Electric, Parsons, Reyrolle and Thorn were 1s to 1s 9d lighter.

The "easier H.P." plea sent by the Radio Industry Council to the Board of Trade, reinforced by disappointing statistics of retail radio and television sales, shows that, on the domestic side at least, credit restrictions are taking a heavier toll. And the latest Federation of British Industries survey, based on the answers of 728 chairmen and managing directors to an FBI questionnaire, clearly illustrates that businessmen are becoming even more cautious.

Asked about their experience of profit margins over the four months to the end of September and their expectations for the next four, 53% said "same again" and 37% answered "down." Only 9% of the replies were expansive. Which perhaps goes part of the way towards explaining why the announcement of Decca's is record results for the year to end-March—with turnover £3·4 up at £25·2 million, net profits £229,000 higher at £1,260,000 and total dividend hoisted from 20% to 23½%—caught the shares at 46s 1½d, a mere 7½d above the 1960 "low."

There was still plenty of money around, however, as was proved by the response to the LCC's £20 million offer of 6% stock. Lists closed after only a minute with the issue heavily oversubscribed. — *From our City Correspondent.*

Alwyn Holdings Ltd.

This concern, which controls Rashleigh Phipps Ltd., is raising the dividend to 12½% for the period of incorporation to 30 June last, compared with the 10% forecast when it became a public company in June, 1959. Group profits, before tax, for the period, amounted to £190,790, of which £186,732 is applicable to the year ended 30 June. Balance for the year compares with £139,352 for the wholly owned subsidiaries in the previous year. Taxation absorbs £101,957, leaving a net profit of £88,833.

Anglo-Portuguese Telephone Co.

It is proposed to issue 1,190,000 new Ordinary £1 shares to Ordinary and "A" Ordinary stockholders on a one-for-one basis at 21s each. The new shares will rank for the final dividend for 1960.

Associated Electrical Industries

Following an expressed preference by the majority of shareholders, this concern is to pay half-yearly dividends in future. The second quarterly dividend of 2½% announced on Tuesday will be the last. Some time ago a questionnaire was sent to shareholders seeking their views. It is evident that many consider any advantages of a quarterly dividend are probably offset by the extra paper work involved.

Sydney S. Bird and Sons

This concern, which makes components for the electronic industry, is not paying an interim dividend "in view of adverse trading conditions."

A. C. Cossor Ltd.

An attempt to upset the present board failed at last week's annual general meeting. Sir Miles Graham, chairman, revealed that the order book was in its best position for many years. For 1961-62, instructions had already been received to proceed with over £1½ million of orders. For 1962-63, the figure was now £725,000 and, for 1963-64, £250,000. He hoped that in due course he would bring the company back to the position it should hold. The company have just purchased a small firm complementary to its radar section, but no bids had been made for Cossor, he added.

Crabtree Electrical Industries Ltd.

Persistent rumours of takeover negotiations were squashed by the directors last week in a statement that "no negotiations have taken place or are contemplated and they have no knowledge of anything likely to have prompted this rumour."

Ever Ready Trust Co. Ltd.

In announcing a gross revenue of £79,210 for the six months ended 30 Sept. last, compared with £65,405 for the same period of last year, the directors are recommending an interim dividend of 8%, against 7% last time.

Rangoon Electric Tramway and Supply Co.

Having agreed with the Burma Government on compensation for the assets of the undertaking, which was taken over in 1953, the liquidators now estimate that they will be able to distribute at least 9s per 15s share. Agreed compensation is kyats 2,22,98,373 plus interest.

George H. Scholes and Co. Ltd.

An adjoining factory, which was surrounded on three sides by their existing land, was acquired by the company earlier this year. This will greatly facilitate development of the whole area, Mr F. J. Pearce, chairman, has told shareholders. The ground floor has already been converted into a store and new offices are being erected to release space in the works for further productive capacity.

Year to 30 June	£ Trading Profit	£ Net Profit	% on Ord.		Ord. Price	
			Earned	Paid	High	Low
1956	253,091	102,010	80	25	15/4½	13/9
1957	259,020	101,722	80	25	10/11	10/6½
1958	303,825	118,567	70	20*	19/6	11/3
1959	378,228	165,125	91	30	36/–	13/4
1960	460,429	201,746	74	27½†	35/1½	33/6

* Plus 40% capital bonus. † Plus 50% capital bonus.

J. and F. Stone Lighting and Radio

This retailing organisation had a better year in the period ending 30 June last. Group trading profit increased to £915,802 (*£617,121*), and after charging taxation at £416,500 (*£246,000*), the net profit is £386,269 (*£280,775*). A final dividend of 22½% raises the total distribution by 5% to 35%.

Dividends Declared

Babcock and Wilcox. Interim 5% (*same*).

Engineering and Lighting Equipment Co. Interim 7½% (5%) on larger capital.

Greengate and Irwell Rubber Co. Interim 5% (same).

Glenfield and Kennedy Holdings. Interim 5% (*same*).

Mavor and Coulson. Interim 4½d per share (*same*) but on increased capital.

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

20 Oct.—Edinburgh C.C. Provision and erection of stage lighting equipment and control board at Trinity Academy Secondary School. Applications to City Architect, City Chmbrs, by above date.

21 Oct.—Bristol C.C. Supply of lamps, batteries, transformers, capacitors, sundries, cables, etc., for year.—Advertised 6 Oct. issue.

21 Oct.—Larbert. (Item 6.) Electrical installations in six houses for Royal Scottish National Institution and in four houses for Bellsdyke Mental Hospital Board of Management. Applications to Secretary, D. M. Johnston, Board of Management Offices, Royal Scottish National Institution, Larbert, by above date.

24 Oct.—Kingston upon Thames. Roof renewal, electrical ancillary works, etc., at Corpn. Depot.—See 29 Sept. issue.

24 Oct.—Lancs C.C. Rewiring of Thornton Cleaveleys County Secondary School. Applications, reference A/G, to County Architect, P.O. Box 26, County Hall, Preston, by above date.

24 Oct.—Pelton P.C. Erection of 30 60 W sodium lamps on concrete columns.—See 6 Oct. issue.

24 Oct.—Renfrew C.C. (3) Electrical installation in proposed primary school at Larkfield, Greenock. Applications to County Clerk, R. Urquhart, County Bldgs, Paisley, by above date.

24 Oct.—S. Devon Water Board. Supply of 1,800 g.p.h. at a 286 ft head duplicate pumps and ancillary equipment for Sheldon Pumping Station.—See 6 Oct. issue.

25 Oct.—Bangor B.C. Supply of 30 fluorescent lanterns/brackets suitable for attachment to E.B. wood poles. Borough Surveyor's Office, Town Hall, Bangor, N.I.

25 Oct.—Ealing B.C. (a) Supply of 88 140 W sodium lanterns/lamps/gear; (b) supply and erection of 85 25 ft steel columns.—Advertised 15 Sept. issue.

25 Oct.—Lewisham B.C. Replacement of m.v. lighting with sodium on 207 columns with supply and installation of 51 Group "A" steel columns, 226 single and 17 twin 200 W sodium lanterns/lamps/gear and 15 with 140 W lamps/gear. Borough Engineer, Town Hall, S.E.6.

26 Oct.—Cardiff C.C. Complete £38,000 electrical installation, by contractors on N.I.C.E.I.C. roll, in proposed Teachers' Training College, Cyncode.—See 29 Sept. issue.

26 Oct.—Eire C.I.E. Form 137. Supply of lamps for premises and automobiles.—See 13 Oct. issue.

26 Oct.—Manchester C.C. (a) Electrical installation and (b) supply and erection of passenger/goods lift in new hostel block, Didsbury Training College.—See 13 Oct. issue.

26 Oct.—Manchester C.C. Replacement batteries for motor vehicles for year to 31 Dec., 1961. General Manager, Corpn. Transport Dept., 55 Piccadilly, Manchester.

26 Oct.—Newbury B.C. Supply and erection at London Rd Pumping Station of two v.s. (each 186,000 g.p.h.) and three (each 75,000 g.p.h.) centrifugal pumps for unscreened sewage.—See 13 Oct. issue.

26 Oct.—Whitchurch U.D.C. Phase 1. Supply, erection and wiring of 45 150 W sodium lamps on 25 ft concrete columns and 59 85 W sodium on 15 ft columns.—Advertised 29 Sept. issue.

28 Oct.—Dunbarton C.C. Erection of 16 200 W linear sodium cut-off lanterns on 35 ft steel columns with 6 ft outreach plus four "Keep Left" bollards complete with ducting cable, control pillar and gear for Auchenkiln Junction, A80, roundabout. Applications to County Lighting Superintendent, W. Arthur, 24 George Sq, Glasgow C.2, by above date.

28 Oct.—Enniskillen R.D.C. Provision of nine fluorescent lamps on concrete columns at Cornagrade. Engineer and Surveyor, A. Stephenson, R.C. Offices, Cornagrade. Deposit £2 2s.

28 Oct.—Manchester C.C. Electrical installation in smoke chamber, Central Fire Station. City Architect, P.O. Box 488, Town Hall.

29 Oct.—Dagenham B.C. Applications for inclusion in approved list of contractors for school maintenance electrical work to Borough Engineer and Surveyor by above date.

29 Oct.—Heston and Isleworth B.C. Rewiring, supply and fixing of power outlets in: Contract 1, 92 houses; Contract 2, 102 houses; and Contract 3, 105 houses on Worple estate, Isleworth.—Advertised 13 Oct. issue.

31 Oct.—Leighton Buzzard U.D.C. Erection of 28 Group "A" Stanton columns complete with lanterns/gear along A4012; resiting including the provision of new lanterns of 17 Group "B" columns and the erection of 33 additional Stanton columns/lanterns along Stanbridge Rd.—See 13 Oct. issue.

31 Oct.—Oldham C.B. Conversion of 15 mechanical public clocks to electric drive or electric wind.—Advertised 29 Sept. issue.

31 Oct.—Taunton B.C. Supply of (Item d) electrical goods for year from 1 Jan., 1961. Town Clerk, Municipal Bldgs.

31 Oct.—Warrington B.C. Contract 1. Supply and erection of submersible well pumps, horizontal centrifugal pumps, switchgear and hydraulic instruments for Houghton Green. Contract 2. Small horizontal centrifugal pumps, etc., for Risley Pumping Station. Water Engineer, Pinners Row.

31 Oct.—Wrexham B.C. (a) Electrical installations in 40 dwellings, Tanat Way and Sutton Drive; (b) supply of consumers' units and cabinets. Borough Engineer and Surveyor, 31 Chester St.

1 Nov.—Harrow B.C. Supply and installation of 120 200 W sodium units on 30 ft steel columns and removal of existing installation along Edgware Rd, A5. Borough Engineer, 48 Uxbridge Rd, Stanmore. Deposit £2.—Advertised in this issue.

1 Nov.—Kingston upon Thames B.C. Erection only of 45 Group "A" columns/140 W sodium lighting and conversion of 125 Group "A" mercury units to sodium. Borough Surveyor, Town Hall. Deposit £2 2s.

1 Nov.—North Down R.D.C. (a) Supply and erection of fluorescent street lighting in 15 villages. Clerk, 2 Church St, Newtownards.

1 Nov.—Wombwell U.D.C. Supply of 250 3 cu ft 240 V refrigerators in quantities of not less than 50. Tenders indicating guarantee/free maintenance to Council Clerk, F. Potter, Town Hall.

4 Nov.—Down C.C. All-electric lighting and heating installation in Child Health and Welfare Clinic, Knocknee Ave, Kilkeel.—See 13 Oct. issue.

4 Nov.—Oldbury B.C. Erection, on fixed-price basis, of 88 Class "B" concrete columns, supply and fitting of post-top lanterns with lamps/control gear/time switches plus resiting of 26 units and conversion to MBF/U operation along various roads. Borough Engineer and Surveyor, Municipal Bank Chmbrs. Deposit £2 2s.

5 Nov.—Longbenton U.D.C. Supply and erection of 64 sodium units and 474 post-top lantern filament Group II street lighting units. Engineer and Surveyor, A. E. Sweetman, Council Offices, Forest Hall, Newcastle-on-Tyne 12. Deposit £3 3s.

5 Nov.—Middlewich U.D.C. Fluorescent lighting installation in (part) Victoria Bldg, Lewin St. Surveyor, D. A. Stubbs, Victoria Bldg.

5 Nov.—New Windsor B.C. Supply of (Item 15) lamps and (Item 21) fittings and cable for year to 31 Dec., 1961.—See 6 Oct. issue.

7 Nov.—Swanage U.D.C. Electrical installation in new depot at King's Rd West. Engineer and Surveyor, P. S. Browne, Town Hall.

10 Nov.—Northwich R.D.C. Supply and installation of 40 Group "A" concrete columns with sodium lamps/lanterns/gear. Engineer and Surveyor, Whitehall, Hartford, Northwich. Deposit £2 2s.

11 Nov.—New Windsor. Electrical installations in two maisonnettes at Clewer New Town.—See 13 Oct. issue.

11 Nov.—Oldbury B.C. Erection, on fixed-price basis, of 20 Class "B" concrete columns, supply and fitting of post-top lanterns/lamps, control gear/time switches on Lion Farm estate. Borough Engineer and Surveyor, Municipal Bank Chmbrs. Deposit £2 2s.

14 Nov.—N.A.T.O. Infrastructure. Provision and proving of a very low-frequency radio-

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources, including an index of trade information with over 100,000 entries

A Selection from the 110 queries answered this week

Stamford Electrical Co., makers of motors—address for? T.E.—Arthur Lyon and Co. (Engrs.) Ltd., Park Wks, Stamford, Lincs.

"Mini-Maid" vacuum cleaners—makers of? M.A.—Bylock Electric Ltd., South St, Enfield, Middx.

"Hameo" appliances—repairers of? S.E.E.B.—Campion Products Ltd., 378 Malden Rd, Worcester Park, Surrey.

"Castle" sterilisers—agents for? M.A.N.W.E.B.—The Amalgamated Dental Co. Ltd., 22 Broadwick St, W.1.

"Mitchell" water heaters—makers of? K.L.—Mitchell Electric Ltd., Meco Wks, 88-89 Tennant St, Birmingham 15.

"Penberthy" pumps—agents for? W.W.—W. H. Willcox and Co. Ltd., 49 Southwark St, S.E.1.

"Samovar" percolators—makers of? L.E.B.—Wm. May and Son (London) Ltd., Dominant Wks, Elthorne Rd, N.19.

"Sumlock" calculating machines—makers of? T.E.—Bell Punch Co. Ltd., 39 St. James's St, S.W.1.

"Panelescent" lighting fittings—makers of? F.W.J.E.I.—Sylvania Electric Products Inc., 60 Boston St, Salem, Mass., U.S.A.

"Kenmore" washing machines—repairers of? E.E.B.—Home Electric Washer Co. Ltd., 17 Aylmer Parade, North Rd, N.2.

telegraph transmitting station in North of England.—Advertised 13 Oct. issue.

16 Nov.—Ipswich B.C. Electrical installation in proposed 56-person aged people's home, Chantry estate. Borough Engineer and Surveyor, 19 Tower St. Deposit £2 2s.

17 Nov.—Birmingham C.C. Socket-outlet installations and lighting installation repairs in 250 houses at Acock's Green. Housing Manager, J. P. Macey, Bush Hse, Broad St.

17 Nov.—Fylde Water Board. Supply of flow recorder panel and hydraulic measuring equipment.—Advertised 13 Oct. issue.

14 Dec.—Matlock U.D.C. Supply and installation complete of nine sewage pumps at four pumping stations in Darley Vale.—See 6 Oct. issue.

No date stated—Haddington B.C. (Item 6). Electrical installation in office reconstruction scheme at Caryle Rooms, Lodge St; and (Item 7) electrical work in 22 houses in seven blocks on Abercroft site.—See 13 Oct. issue.

No date stated—N. of Scotland H.E.B. 60 MVA transformer for Persley substation, Aberdeen.—Advertised 13 Oct. issue.

No date stated—St. Faith's and Aylsham R.D.C. Supply of columns, lanterns, lamps and auxiliary equipment.—See 13 Oct. issue.

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon Hse, Theobalds Rd, W.C.1, quoting reference.*

27 Oct.—S. Africa. 90,000 2·8 V air-depolarised cells. Secretary, Union Tender Board, P.O. Box 371, Pretoria. B.o.T. (ESB/26627/60).*

1 Nov.—America. One 10·5 MVA and one 6 MVA 3-ph. outdoor transformers. Dept. of the Interior, Bureau of Reclamation, Bldg 53, Denver Federal Center, Denver 25. B.o.T. (ESB/26481/60).*

1 Nov.—America. 3,743 10 in. diameter suspension insulators. Dept. of the Interior, Bonneville Power Admin., 1001 N.E. Lloyd Boulevard, Portland, Oregon. B.o.T. (ESB/26623/60).*

1 Nov.—Ceylon. Air conditioning plant for Stanley and Laksapana control rooms. Electrical Engineer, Contracts and Supplies, McCallum Rd, Colombo. B.o.T. (ESB/26494/60).*

1 Nov.—Pakistan. Seven items p.v.c. flat twin cables from 3/·029 to 7/·064 in quantities up to one million yd. Director of Stores, W.P.D.A., Gardee Trust Bldg, Lake Rd, Lahore. B.o.T. (ESB/26696/60).*

1 Nov.—Sudan. 20 7·4 cu ft refrigerators. Director of Stores and Equipment, Khartoum North. B.o.T. (ESB/26629/60).*

7 Nov.—India. Five items o/h travelling cranes, three to 30 tons and two two-ton semi-Goliath cranes. Deputy Chief Mechanical Engineer, Steel Foundry, Chittaranjan Locomotive Wks, West Bengal. B.o.T. (ESB/26677/60).*

7 Nov.—India. 11 kV cables for Sumar Power Station. Additional Chief Engineer (Electrical), Assam State Electricity Board, Lachumiere, Shillong. B.o.T. (ESB/26673/60).*

8 Nov.—Ceylon. Generating sets for Ratnagama, Imaduwa and Galle. Electrical Engineer, Contracts and Supplies, McCallum Rd, Colombo. B.o.T. (ESB/26490/60).*

17 Nov.—Iran. 30 battery-operated fork-lift trucks to lift 2,000 kg to 12 ft. General Customs Admin., Ministry of Customs and Monopolies, Teheran. B.o.T. (ESB/26669/60).*

28 Nov.—Sudan. Two 15 cu ft 110 V d.c. refrigerators for Sudan Railways. Controller of Stores, Atbara. B.o.T. (ESB/26679/60).*

30 Nov.—India. Two 250 kVA transformers for Sumar Power Station. Additional Chief Engineer (Electrical), Assam State Electricity Board, Lachumiere, Shillong. B.o.T. (ESB/26676/60).*

5 Dec.—India. 125 V battery banks, chargers and d.c. control boards for Umiam (Barapani) Hydel Project. Additional Chief Engineer (Electrical), Assam State Electricity Board, Lachumiere, Shillong. B.o.T. (ESB/26672/60).*

10 Dec.—India. Power line carrier communication equipment for Umiam (Barapani) Hydel Project. Additional Chief Engineer (Electrical), Assam State Electricity Board, Lachumiere, Shillong. B.o.T. (ESB/26675/60).*

Gazette Announcements

COMPANIES ACTS

Inter-city Electric Machines Ltd. Meeting of creditors to be held at 233 High St, Poole, on 21 Oct., at 10.30 a.m.

Tape Recorder Service Co. Ltd. Meeting of creditors to be held at 194 Bishopsgate, E.C.2, on 25 Oct., at 12 noon.

Penelectric Appliance Co. Ltd. Meeting of creditors to be held at Law Institute, Albion Pl, Leeds, on 20 Oct., at 2.30 p.m.

R. Giddings and Co. Ltd. Petition for winding-up to be heard before the High Court of Justice, Strand, W.C.2, on 24 Oct. Persons intending to appear to notify Cochrane and Cripwell, 119 Finsbury Pavement, by 1 p.m., 22 Oct.

A. and R. Direct Supply Co. Ltd. Petition for winding-up to be heard before the High Court of Justice, Strand, W.C.2, on 24 Oct. Persons intending to appear to notify Lipton and Jefferies, 39 Jermyn St, S.W.1, by 1 p.m., 22 Oct.

Minisales Ltd. Petition for winding-up to be heard before the High Court of Justice, Strand, W.C.2, on 24 Oct. Persons intending to appear to notify H. E. Goodrich, 9 Union Court, Old Broad St, E.C.2, by 1 p.m., 22 Oct.

Elizabethan Eng. Co. Ltd. Mr H. E. Hassell, 8 Queen St, E.C.4, and Mr H. C. Hedges, 4 Charterhouse Sq, E.C.1, appointed joint liquidators at extraordinary general meeting on 12 Oct. for the purpose of voluntarily winding-up.

BANKRUPTCY ACTS

Receiving Order

Slough. J. S. Sizmore, electrical retailer and contractor, of 12 Stoke Rd, Slough. Receiving order dated 7 Oct.

Intended Dividend

Truro and Falmouth. G. B. Solomon, radio and electrical dealer, carrying on business as St. Columb Radio, at 57 Fore St, St. Columb. Last day for receiving proofs for intended dividend: 25 Oct., to trustee: J. E. Ellis, 50 The Terrace, Torquay.

CONTRACTS PLACED

Cheadle and Gatley U.D.C. Supply and erection of 39 Group "A" concrete columns with 140 W sodium lamps/lanterns, Cohen Bros. (Electrical) Ltd.

Cheltenham B.C. Electrical installations in 38 dwellings at Maud's Elm, M. B. Owen, £1,298. Recommended.

Darlington T.C. Electrical installation in practical block, Salters La Open-Air School, Cox-Walkers Ltd., £407.

Gateshead T.C. Electrical installation in Elgin Secondary Technical School, Campbell and Isherwood Ltd. Recommended.

Guildford B.C. Electrical services in new central library, T. A. Boxall and Co. Ltd., £5,965. Recommended.

Hatfield D.C. Supply and erection of 38 tubular steel columns and lanterns for Oxlease development areas lighting, Abacus Municipal Ltd.

Seaton Valley U.D.C. Electrical installations in 86 new houses, W. Hinton.

Sheffield C.C. Electrical installations in Broomgrove and Woodville hostels, T. W. Sampson and Co. Ltd., £13,083 and £11,017. Recommended.

Watford B.C. Supply, erection and wiring of 93 concrete columns along A405, Midland Lighting and Bldg Ltd., £3,613.

Wessex Hospital Board. Lift installation, "H" block, Christchurch Hospital, Pickerings Ltd., £4,278: electrical work in E.N.T. wards, Royal Hants County Hospital, and in stages I and II, Lord Mayor Treloar Hospital, Dicks Ltd., £1,498, £4,191 and £2,030, respectively. Recommended.

Willesden B.C. Electrical installations in central library extension, C.J.L. Electrical Ltd., £1,306. Recommended.

TRADE NOTES

Changes of Address. Line Equipment Ltd. have moved to 71a Queen Victoria St, E.C.4. The telephone no. remains City 1841.

Conduit Distributors Ltd. have this week moved to new premises at Leek St corner, King's Cross Rd, W.C.1. Telephone: Terminus 7842.

In view of the rapid expansion of the Instrument Division of E.M.I. Electronics Ltd., the Development Section of that Division will in future operate from Wells, Somerset, instead of Hayes, Middlesex.

The Birmingham office and depot of Oldham and Son Ltd. is now at Norwood Rd, Bordesley Green, Birmingham 9.

New Telephone No. The telephone no. of Leicester, Lovell and Co. Ltd. has been changed to Rownhams 2131.

BEAMA Contract Price Adjustment Formulae. *For Electrical Machinery and Equipment.* For purposes of calculating variations in (*a*) "Rates of Pay"—the rate of pay for adult male labour at 14 Oct., 1960, shall be deemed to be 204s 6d; (*b*) "Cost of Material"—the index figure for materials used in the Electrical Machinery Industry at 14 Oct., 1960, is 116·7* (181·0*).

For Turbo-Generating and Allied Plant. For purposes of calculating variations in: (*a*) "Rates of Pay"—the rate of pay for adult male labour at 14 Oct., 1960, shall be deemed to be 204s 6d; (*b*) "Cost of Material"—the index figure for Materials used in the Mechanical Engineering Industry at 14 Oct., 1960, is 126·3* (189·8*). "Blast Furnaces and Iron and Steel Melting and Rolling (1948 S.I.C. ref. 40/41)." 189·5*. Other Steel Goods, excluding tubes (1958 S.I.C. ref. 311/2). 129·1*. The price of brass condenser tubes ¾ in. o/d 18 s.w.g. on 14 Oct., 1960, is 3s 11½d per lb. *Provisional figure.

The figures in parentheses shown above relate to the earliest list of wholesale price index numbers in which the year 1949 is taken as the base 100. For the other figures 1954=100.

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Dishtron. 807,621. Class 7. Dish-washing machines. Halpins (Dishtron) Ltd., 57-61 London Rd, Southampton, Hants.

Emicon. 801,835. Class 9. Scientific and electrical apparatus, etc. E.M.I. Electronics Ltd., Blyth Rd, Hayes, Middx.

Rotoshine. B801,656. Class 7. Polishing machines (not domestic). B801,657. Class 9. Electric domestic polishing machines. Pye Ltd., Radio Wks, St. Andrew's Rd, Cambridge.

Slumberland. 801,848. Class 10. Electric blankets, etc. Slumberland Ltd., Redfern Rd, Tyseley, Birmingham 11.

BUSINESS PROSPECTS

Accrington. Finch Watson, Ramsbottom St, plan light engineering works on Marlborough Rd land.—The Calico Printers Assoc. plan extensions to their calender room at Broad Oak Print Wks.

Bangor B.C. Tender: 137 houses, 84 flats. Town Clerk.

Barnstaple. E. F. Hamilton-Parks, 116 Piccadilly, W.1, architect for planned Ayers and Grimshaw factory.

Barrow-in-Furness. Continuous casting plant planned at Barrow Steelworks Ltd.

Bexhill. Harvey, Struth and Co., 77 George St, W.1, surveyors for block of flats, shops, etc., at Marina, Devonshire Rd, and Eversley Rd.

Birmingham T.C. Tender: Aged persons' home, Birchfield Rd, Perry Barr, for Welfare Committee. Architect.—Home for the Handicapped, Chamberlain Gdns, Ladywood. Architect.

Bishop Auckland. Hardy Ltd. plan warehouse in Newgate St. Architects: Pigg and Son, 88 Newgate St.

Blackburn. Daniel Thwaites and Co., Star Brewery, plan rebuilding of Waterloo Hotel.

Bodmin. R.C. authorities plan new school at St. Mary's Abbey.

Bolton. A. Holmes and Co. plan extensions to works off Bradford St.

Bradford. Sir John Burnet, Tait and Ptnrs, 10 Bedford Sq, W.C.1, architects for new Belle Vue boys' grammar technical school.—Clyde Young and Bernard Engle, architects for Margaret McMillan Training College.

Brentwood. W. Clark and Ptnrs, 55 Pall Mall, S.W.1, architects for £¼ million factory planned at Ongar Rd for Thermos.

Buxton P.C. Provision of Group "A" lighting on trunk road, A264 (part), at £1,500 planned.

Camberley. R. T. James and Ptnrs, 6 Lower Grosvenor Pl, S.W.1, architects for Rockweld's £60,000 offices.

Cardiff. Large scale development is to replace old Butetown slum, including two 16-storey tower blocks of flats. City Architect.

Chatham. R. D. Batchelor, Luton, Chatham, plan factory at Princes Ave.

Chester-le-Street. Howardsgate Holdings, Welwyn Gdn City, plan warehouse, offices, etc., at Pelaw Hill Farm.

Coventry. Corporation to make available nearly two acres, Charter Ave industrial estate land, to Hibberd and Sons, Warwick St garages.

Dagenham. Jessups (Romford), London Rd, Romford, plan factory for body building works and repair of motor vehicles, Freshwater Rd.—N. Harris and Sons plan single-storey building at Dominion Wks, Freshwater Rd.—Ratcliffe and Son (Printers) plan extensions to 160-162 High Rd works.

Dalkeith T.C. Tender: Final development of Duke's Park housing site: 48 houses, etc. Quantity surveyors: Morham and Brotchie, 29 Hanover St, Edinburgh.

Darlington. Darlington Co-op. and Industrial Society, Priestgate, plan departmental walk-around store in Tubwell Rd. C.W.S. Architects' Dept., 9 Westmorland Rd, Newcastle—Samuel Smith, Old Brewery (Todcaster), plan residential hotel in town.

Dewsbury B.C. Tender: 120 dwellings, Foxroyd La housing estate, and 12 Whitley bungalows. Architect and Bldgs Surveyor.

Dundee. £70,000 improvements planned for maternity department at Royal Infirmary.

Durham. T.C. plan 48 houses on Newton Hall estate. Engineer.—R. E. Coleman, Carrville, to erect 68 Carrville houses.

Eastbourne. Photax Ltd., 1 Charlotte St, W.1, plan factory of plot 32, Brampton Rd estate.

East Riding of Yorks C.C. Tender: Three-form entry school at Norton. Also home for aged at Norton. Architect, Beverley.

Egham, Surrey. L.C.C. plans development of Shoreditch Training College at Egham; cost: £485,000. Plans by Architects' Department, County Hall, S.E.1.

Eltham, Kent. Tender: Office block at Eltham Palace for Army Institute of Education. Architects: Bryan and Norman Westwood and Ptnrs, 21 Suffolk St, S.W.1.

Felling. Arthur and Kirkup, 13 Swinburne St, Gateshead, architects for meat packing plant and slaughterhouse at Green La, for R. A. Dodds, 178 Butcher Market, Newcastle.

Fylde Water Board. Tender: Double-storey office and stores, Coleridge Rd Depot, Blackpool. Engineer to the Board, Sefton St, Blackpool.

Gateshead B.C. Tender: Chandless redevelopment area, Phase II, 232 dwellings; (2) Mendip Gdns, Lobley, 12 dwellings and six four-bedroom houses; (3) Yetholm Rd, 30 dwellings; (4) Rectory site, Bensham Rd, 52 dwellings. Surveyor, Swinburne St.—E.C. plan £9,000 additions to The Cedars Special School. Engineer.—£20,000 old people's luncheon club planned for Wrekenton. Engineer.

Glasgow. £1½ million scheme planned to extend Glasgow Museums and Art Galleries at Kelvingrove by Corporation Museums and Art Galleries Committee.

Guildford. W. Earle-Yeates, 154a Church Rd, Hove, architect for planned factory on industrial estate for Transformers and Rectifiers Ltd.

Guisborough U.D.C. Tender: 19 bungalows, Lazenby. Surveyor.

Hyde, Ches, B.C. Tender: 32 houses, 20 maisonnettes and 20 flats, Lilly St housing estate. Surveyor.

Isle of Wight. C.C. plan £63,000 factory at Binstead to accommodate Columbia Products, 1 Dukes Ave, W.4.

Kidderminster. Wallis Gilbert and Ptnrs, 5 Cromwell Rd, S. Kensington, S.W.7, architects for £350,000 administration block planned for Carpet Trades Ltd., Mill St.

Langley, Bucks. Warehouse extensions at considerable cost planned by Pasolds Ltd., Langley.

Leeds T.C. (a) Scheme 875, 86 bungalows and ten houses, Cardigan La, Moorside, Belle Isle and Gipton; and (b) Scheme 870, 32 garages, Quarry Hill flats. Architect.

Leics C.C. Extensions planned to Blaby Junior, Ibstock Secondary and Burbage Hastings High schools. Total cost £188,823.

London. N. Raymond Spratley and Ptnrs, 9 Hertford St, W.1, architects for £35,000 Capitol Hse, and office block at Green Lanes, Winchmore Hill, for Rodwell Group.—**N.W.** Royal College of Physicians, Pall Mall East, S.W.1, plan building at Somerset Hse site, St. Pancras.—**S.E.** E. R. Collister and Assoc., 70 Victoria St, S.W.1, architects for Gardiner and Gulland's warehouse planned at Staplehurst Rd, S.E.13.—Tunnel Glucose Refineries plan amenities building and additional storey over Tunnel Ave laboratory.—J. Stone and Co., Anchor and Hope La, plan multi-storey office block.—**S.W.** Ministry of Works plan acquisition of block, Bridge St/Parliament St/New Scotland Yd/Embankment, for Government offices.—Richardson and Davies, 57 Queen Anne St, W.1, quantity surveyors for shops and flats at Lower Sloane St and Pimlico Rd for Cadogan Estates.—A. Vernon and Ptnrs, 5 Buckingham Pl, S.W.1, architects for Redifon's proposed extensions.—L.C.C. Welfare Committee have approved scheme for old people's home at 367 Fulham Rd at £164,760.—Education Committee approves development of Mount Clare and Devonshire Hse sites, Wandsworth, for use of Garnett Training College for Technical Teachers, cost £461,000.—**W.** City Centre Properties, 32 Victoria St, S.W.1, plan redevelopment of 45 Park La.—Cecil Burns and Guthrie, 11 Calverley Park, Tunbridge Wells, architects for six-storey nurses' hostel, Wimpole St, W.1.—R. H. McEwan, 10 Carteret St, S.W.1, quantity surveyor for £120,000 warehouse rebuilding at Heathfield Terr, W.4, for Army and Navy Stores Ltd.

Luton. Swannell Stove Enamelling Co. plan new building for metal work at 330 Selbourne Rd.

Manchester. Tender: Erection of holiday camp and motel on south west coast: 300 chalets with baths, three dining halls, reception centre, two ballrooms, two snack bars, four licensed bars, theatre, cinema, service station, etc. Burkland Mayfair Bldgs, 19 Downing St, Manchester 1.—T.C. Tender: Contract 352, 42 dwellings, Butler St, and 354, 229 dwellings, Collyhurst St. Director of Housing, Town Hall.—Heaton Mills Printing Co. plan extensions to Heaton Mills, Higher Blackley.

Newcastle T.C. Tender: 181 houses, 16 flats and garages, Newbiggin Hall estate, Groups 14, 17, 18 and 19. Architect.—E.C. plan £6,000 improvement of Whickham View School electric lighting.

Northallerton. Tender: Friarage Hospital nurses' home extensions, for Newcastle Hospital Board. Architects: Mortimer Ptnrs, Ainderby Hall.

Norton-Radstock U.D.C. Tender: 40 dwellings, Springfield, Radstock, comprising flats and maisonnettes. Redwood, Miles and Wills, architects, 18 Gt. George St, Bristol.

Oldbury B.C. Tender: (a) 32 dwellings; (b) 30 dwellings; and (c) 55 dwellings on Lion Farm estate. Engineer.

Redditch. Wm. Tyers and Co. plan factory at Beoley Rd.—Reynolds T.I. Aluminium plan extensions to tube mills, Studley Rd.—Super Oil Seals and Gaskets plan extension to factory at Studley Rd.—Road Rollers Ltd. plan new plant depot and offices, Studley Rd.

Rochester T.C. Tender: Warren Wood redevelopment, Stage 5; 38 three-bedroom houses and garages, Earl estate, Part IC; 63 three-bedroom houses and garages. Surveyor.

Rotherham. Steel, Peach and Tozer, Rotherham, plan amenity centre and offices, The Ickles, Sheffield Rd: also a maintenance workshop at Templeborough Wks.

Shaftesbury B.C. Tender: Four houses and five bungalows, St. James St. Clerk, 28 Bell St.

Sheffield. Stanley Works (Great Britain), Rutland Rd, Sheffield 3, plan industrial development on land at Woodside La and Birley St.

Smethwick. W. E. Shotton and Co. plan factory extensions, Rabone La.—Dartmouth Auto Castings Ltd. plan production and cupola building, Dartmouth Rd.—Guest, Keen and Nettlefolds plan new implement shop, Thimblemill Rd.

Spennymoor U.D.C. 13 houses, Byers Green; and 16, Tudhoe Moor planned. Gray and Ptnrs, Camden St, North Shields, architects.

Staines. Petters Ltd. plan new research centre.

Stanley U.D.C. Tender: 22 two-bedroom houses, Church La estate, Outwood. Engineer and Surveyor: J. Hustwit, Coach Rd, Outwood.

Stockton-on-Tees. Ashmore, Benson Pease and Co. plan engineering works extensions, Bowesfield La.—Newcastle Hospital Board, Benfield Rd, Newcastle, plan new X-ray department at Stockton and Thornaby Hospital. Board's own architect.

Thornaby-on-Tees T.C. 19 Lanehouse Rd bungalows planned. Engineer.

Tottenham B.C. Tender: 14 dwellings in one block, Braemar Rd/Kent Rd. Engineer.

Ware. Wood Bros. (Brimsdown), London Rd, Ware, plan six factories at Marsh La.

West Bromwich. Johnson Iron and Steel Co., Church La, plan rolling mill, ancillary mill, offices, etc., at Church La.

Whitley Bay. F. G. Frizzell, 80 Portland Pl, W.1, architect for United Automobile Services' garage extensions.

Widnes B.C. Tender: Wake Deacon Grammar School for Girls. Architect, Brendan Hse, Widnes Rd.

Wores C.C. Tender: Bromsgrove Rubery infants' school and clinic. Architect.

MEETINGS TO NOTE

THURSDAY, 20 OCT.

I.E.E. (N. Midlands). "The Supply Authorities' Problems," H. Anderson; "The Consultants' Problems," C. H. Nicholson; and "The Users' Problems," A. Minty. Lecture Theatre, Y.E.B. Offices, Ferensway, Hull. 6.30 p.m.

I.E.E. (N.E. Graduate and Students). "Electrical Phenomena at very Low Temperatures," R. E. Hayes. Grey Hall, King's College, Newcastle. 6.30 p.m.

CHELMSFORD ENGINEERING SOCIETY. "Introduction to the Age of Nuclear Fower," W. G. Busbridge. Social Hall, Crompton Parkinson. 7.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (Scotland). "Process Plann ng and Machine Tool Control Systems," A. Tack and J. Brett. Institution of Engineers and Shipbuilders, 39 Elmbank Cres, Glasgow. 7.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS (Southern). "Equ pment Peripheral to Digital Computers," E. J. Petherick. Polygon Hotel, Southampton. 7.15 p.m.

I.E.E. (Cambridge Electronics and Measurement Group). "Frequency Variations of Quartz Oscillators and the Earth's Rotation in Terms of the N.P.L. Caesium Standard." L. Essen, J. V. L. Parry and J. McA. Steele. Cavendish Laboratory. 8 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (E. Midlands). "Instrumentation at the British Railways Research Department, Derby," J. H. Littlewood and A. Kettley. University, Leicester. 7.15 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Grangemouth). "Analytical Instruments for Process Control," Dr D. G. Stevenson. Leapark Hotel. 7 p.m.

DIESEL ENGINE USERS' ASSOCIATION. A.G.M. and "Latent Heat Cooling and Waste Heat Recovery," C. Brett-Littlech ld. Institute of Marine Eng neers, 76 Mark La, E.C.3. 2.30 p.m.

S. WALES INSTITUTE OF ENGINEERS. A.G.M. and presidential address, C. C. Bleach. Park Pl, Cardiff. 6 p.m.

FRIDAY, 21 OCT.

I.E.E. (Southern). "The Application of Irradiation in Industry," M. C. Crowley-Milling. S.E.B. Showrooms, Newport, I.W. 6.30 p.m.

I.E.E. (W. Wales). Annual dinner/dance. Langland Bay Hotel, Swansea. 7.30 p.m.

BIRMINGHAM ELECTRIC CLUB. Annual dinner. Grand Hotel.

JUNIOR INSTITUTION OF ENGINEERS. "Boiler Management in Small Plants," L. Clegg. 14 Rochester Row, S.W.1. 7 p.m.

A.S.E.E. (Aldershot and Districts). Dinner/dance. Victoria Hotel.

A.S.E.E. (Liverpool and District). "Nuclear Power and Propulsion," R. V. Moore. Lecture Theatre, Chadwick Physics Laboratory, Liverpool University. 7.30 p.m.

A.S.E.E. (Stoke and Crewe). "Silicones and Their Applicat ons in the Electrical Industry," J. H. Davis. Grand Hotel, Hanley. 7.30 p.m.

MONDAY, 24 OCT.

I.E.E. (E. Anglian). "Electrical Installation Practice," E. J. Sutton. Electric Hse, Ipswich. 6.30 p.m.

I.E.E. (N. Eastern). "Safety in the Utilisation of Electricity," S. J. Emerson. Neville Hall, Westgate Rd, Newcastle. 6.15 p.m.

I.E.E. (N. Western). Discussion, "Selection of Students for Appropriate Courses." Bolton Technical College. 6.15 p.m.

I.E.E. (S. Midlands Electronics and Measurement Group). "Automatic Control of Machines for Assembling Bicycle Parts," A. V. Hemingway and R. L. Dressler. James Watt Memorial Institute, Birmingham. 6 p.m.

I.E.E. (W. Utilisation Group). Chairman's address, "Developments in Electrical Plant for Industry," J. M. Ferguson. S. Wales Institute of Engineers, Park Pl, Cardiff. 6 p.m.

I.E.E. (Sheffield). Chairman's address, "Electrical Contracting in Commerce and Industry," E. J. Lilleker. Angel Hotel, Brigg. 7 p.m.

I.E.E. (N.W. Graduates and Students). "A.C. and D.C. Variable Speed Drives, E. Hall. Electrical Engineering Department, Manchester University. 7 p.m.

I.E.E. (London Graduates and Students). Chairman's address. "Southern Region, Kent Coast Electrification Scheme—Power Supply Apparatus." Savoy Pl, W.C.2. 6.30 p.m.

TUESDAY, 25 OCT.

I.E.E. (Measurement and Control Section). "Rapid Methods for Ascertain ng Whether the Activity of a Weak Radioactive Sample Exceeds a Predeterm ned Level." E. H. Cooke-Yarborough and R. C. H. Barnes. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (N. Eastern). "Safety in the Utilisation of Electricity," S. J. Emerson. Carlisle Technical College. 7 p.m.

I.E.E. (N.W. Supply Group). "Field Suppression of Turbo-alternators," J. R. Hill, A. Hunt, W. J. Joyce and D. H Tompsett. Engineers' Club, Manchester. 6.15 p.m.

I.E.E. (S. Midlands Graduates and Students). "Stereophonic Sound," K. N. Hawke. Alfred Herbert Hall, Coventry. 7 p.m.

I.E.E. (N. Staffs Graduates and Students). Senior chairman's address, G. H. Gillam. Swan Hotel, Stafford. 7.15 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY. "A New Method of Strip Speed Measurement Using Random Waveform Correlation," M. A. Butterfield, G. F. Bryant and J. Dowsing. Manson Hse, 26 Portland Pl, W.1. 7 p.m.

A.S.E.E. (Portsmouth and District). "Safety in the Utilisation of Electricity," S. J. Emerson. H.M.S. Collingwood, Fareham. 7.30 p.m.

WEDNESDAY, 26 OCT.

I.E.E. (Electronics and Communications Section). Chairman's address, "Channelling—A Sketch," T. B. D. Terroni. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (N. Western). "Electricity in the Manufacture of Hydrogen Peroxide," B. E. A. Vigers and R. O. Fletcher. Lostock Alkali Social Club, Lostock Gralam, nr. Knutsford. 6.30 p.m.

I.E.E. (S. Midlands). Discussion, "The Non-destructive Testing of Materials." College of Advanced Technology, Birmingham. 6 p.m.

I.E.E. (Rugby). "Water-turbine-driven Induction Generators," C. L. C. Allen. Rugby College of Technology and Arts. 6.30 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS. Symposium on New Components until 27 Oct. School of Pharmacy, Brunswick Sq, W.C.1.

BRITISH INSTITUTION OF RADIO ENGINEERS. (W. Midlands). "Industrial Applications of Automatic Control Using Electronic Techniques," R. J. F. Howard. Department of Electrical Engineering, University of Birmingham, Edgbaston, Birmingham. 6.15 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS (S. Western). "Radio Aids for Automatic Landing Developed by the Blind Landing Experimental Unit," J. S. Shayler. School of Management Studies, Unity St, Bristol. 7 p.m.

I.E.S. (Leicester). "Light Sources and Their Applications," H. R. Ruff. A.E.I. Lamp and Lighting Co., Melton Rd. 6.15 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (S. Wales). "The Automatic Control of Rolling Mills," W. N. Jenkins. Lecture Theatre of the Steel Co. of Wales Ltd., Port Talbot. 5.30 p.m.

THURSDAY, 27 OCT.

I.E.E. "The Principles and Operation of Large Radio Telescopes," A. Hewish. Savoy Pl, W.C.2. 5.30 p.m.

I.E.E. (S. Midlands). "Some Aspects of Engineering in Polar Regions," D. L. Pratt. Midland Institute, Birmingham. 6.30 p.m.

I.E.E. (Southern Graduates and Students). "Gramophone Pickups for Stereo and Mono Reproducers," D. J. Edwards. Technical College, Brighton. 6.30 p.m.

I.E.E. (N. Scotland). Sub-centre chairman's address, L. F. Dorward. Electrical Engineering Department, Queens College, Dundee. 7 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Chester). "Analogue Computers," W. E. Willison. Lecture Theatre, Administrative Building, The Associated Ethyl Co. Ltd., O.I Sites Rd, Ellesmere Port, Wirral. 7 p.m.

A.S.E.E. (E. and W. Kent). Dinner. Star Hotel, Maidstone.

A.S.E.E. (S. London). "Industrial Applications of Isotopes," T. B. Rowly. Greyhound Hotel, High St, Croydon. 8 p.m.

A.S.E.E. (N. Ireland). "Protection Equipment for Industrial Plant," Dr W. L. Stern. Central Hall, Rosemary St, Belfast.

A.S.E.E. (Oxford and Districts). "Interference Suppression in Industrial and Research Establishments," A. C. F. Leadbitter. Reactor School, Harwell. 5.45 p.m.

FRIDAY, 28 OCT.

I.E.E. (N. Scotland). Sub-centre chairman's address, L. F. Dorward. Robert Gordon's Technical College, Aberdeen. 7.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Scottish). "Instrumentation of a Steel Strip Mill," H. Gill. Building Centre, Sauchiehall St, Glasgow. 7.15 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Cheltenham). "The Atomic Clock," L. Essex. Belle Vue Hotel. 7.30 p.m.

A.S.E.E. (Coventry and District). "Technical Education for the Electrical Engineer," M. M. Robins. E.M.E.B. Sports and Social Club, Merrick Lodge, Sandy Lane. 8 p.m.

SATURDAY, 29 OCT.

A.S.E.E. (Bradford and District). Dinner. Gt. Northern Hotel, Bridge St. 7.30 p.m.

MONDAY, 31 OCT.

I.E.E. (E. Anglia). "Modern Coal-fired Power Stations," A. E. Hawkins. Assembly Hse, Norwich. 7.30 p.m.

I.E.E. (Mersey and N. Wales). "The Application of Irradiation in Industry," M. C. Crowley-Milling. Royal Institution, Colquitt St, Liverpool. 6.30 p.m.

I.E.E. (N.E. Measurement and Electronics Group). "New Amplifying Techniques," Prof C. W. Oatley. Rutherford College of Technology, Newcastle. 6.15 p.m.

I.E.E. (Malvern Group). A.G.M. and "Applications of Microwaves," Prof A. L. Cullen. Winter Gdns, Gt. Malvern. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEEERS (Applied Mechanics and Lubrication Groups). Discussion: 'Roller Bearing Problems—Is There a Need for Fundamental Research?" Birdcage Walk, S.W.1. 6 p.m.

I.E.S. (Leeds). "Ship Lighting—Perils and Prospects for the Lighting Engineer," J. T. Grundy and G. H. Vaughan. Institute of Technology, Bradford. 7 p.m.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons Ltd., 116 Chancery La, W.C.2.

Bobrich (G.B.) Co. Ltd. Domestic, industrial and labour-saving electrical appliances, etc. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: C. W. Good and C. T. S. Belk, 66 Queen St, E.C.4.

M. Boulter Ltd., 346a Humberstone Rd, Leicester. Electrical engineers and contractors, etc. Nom. cap.: £1,000. Dirs.: Maurice Boulter and Mrs Elsie V. Boulter.

P. J. Bullen Ltd. Electrical engineers, etc. Nom. cap.: £100. Dirs.: to be appointed by subscribers. Subs.: Alexander S. M. Hetherington, Coteswood, Mayford, Woking; and Peter J. Bullen, 11 Russell Rd, Horsell, Woking.

Castell Locks Ltd., Kingsbury Wks, Kingsbury Rd, N.W.9. To acquire the goodwill and certain of the assets of Castell Locks Ltd. (in liquidation), to carry on business as manufacturers of and factors of locks, etc. Nom. cap.: £10,000. Dirs.: Denis P. Castell, Annie L. Castell, Margaret E. Harries and David G. Roberts.

Dowty Technical Developments Ltd. Designers, developers, manufacturers and contractors for and repairers of and dealers in equipment, apparatus, plant and machinery, etc. Power is also taken to carry on business as manufacturers of and dealers in plastics and plastic materials, etc. Nom. cap.: £10,000. Dirs.: not named. Subs.: Michael J. Cansdale, Saddlers Hall, Gutter La, E.C.2: and Anthony H. Isaacs.

G.E.C.-Simon Carves Atomic Energy Co. Ltd. Nom. cap.: £50,000. Dirs.: to be appointed by subs. Subs.: Richard B. Catlow, 62 London Wall, E.C.2: and Philip M. Bevan-Thomas, 20 Copthall Ave, E.C.2.

Roband Valve Co. Ltd., 55-56 Lincolns Inn Fields, W.C.2. Manufacturers of and dealers in electrical, radio, television, mechanical and engineering components, etc. Nom. cap.: £100. Dirs.: Bernard S. Gold and Mrs Ellen Robinson.

Universal Electric Motor Co. (Enfield) Ltd., 2 Constance Rd, Enfield. Nom. cap.: £1,000. Permanent dirs.: Richard C. Hull, Victor H. Hull, Alice C. Hull and Richard C. Hull.

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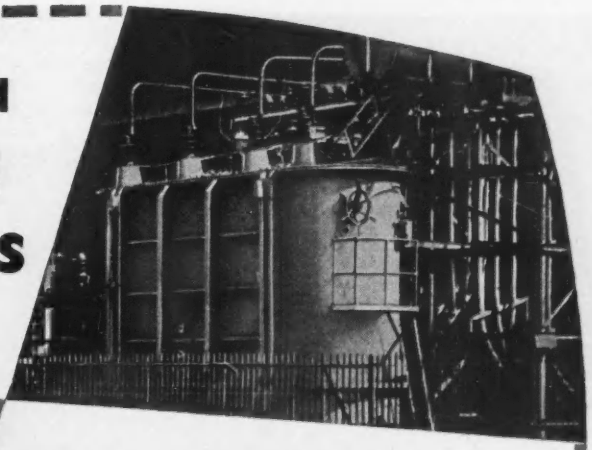

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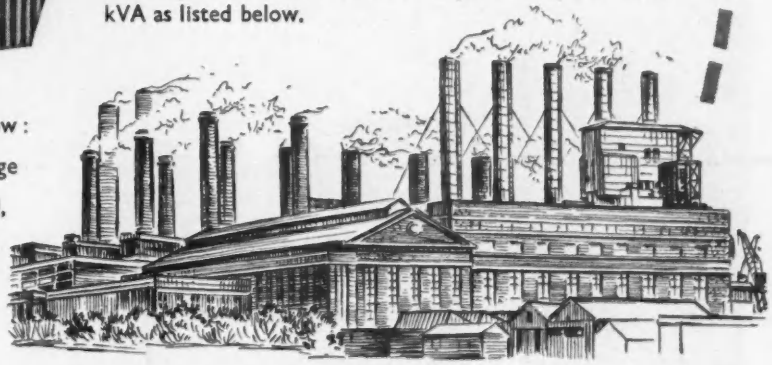
HACKBRIDGE TRANSFORMERS have been installed at Barking Power Station over a period of a quarter of a century and include units in capacities up to 93,750 kVA as listed below.

The installations illustrated show: above, one of the four Hackbridge 93,750 kVA transformers, and, below, one of the three 88,750 kVA Units at Barking Power Station, London.



Four 93,750 kVA	Two 12,500 kVA	Four 600 kVA
Three 50,000 kVA	Two 10,000 kVA	Four 900 kVA
Three 88,750 kVA	Five 7,500 kVA	Four 250 kVA
Four 30,000 kVA	Four 4,500 kVA	Four 150 kVA

Also other miscellaneous units totalling 4,000 kVA

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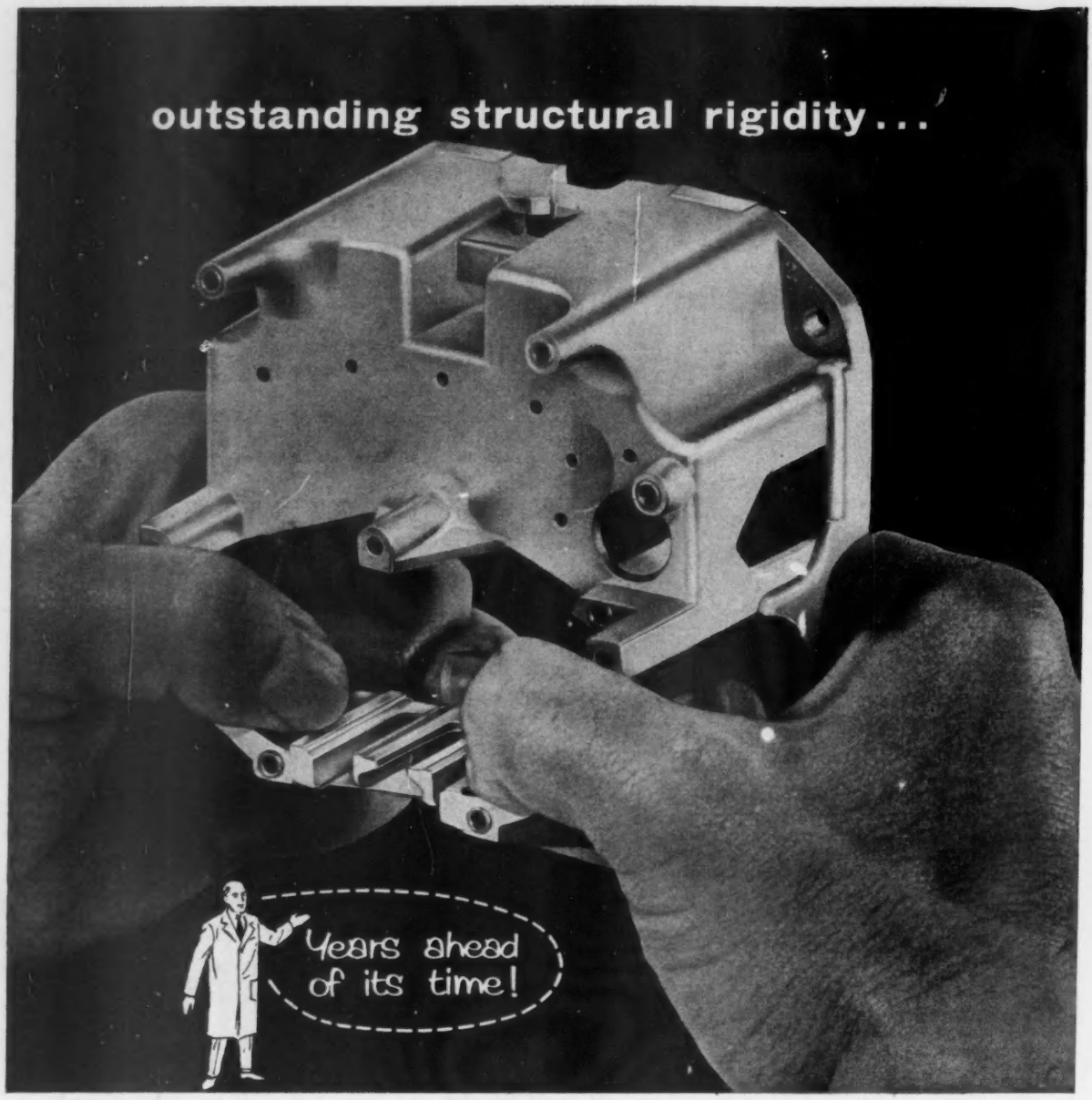

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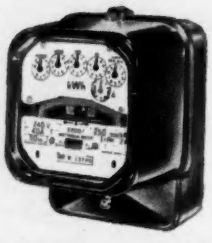

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SW/77

CLASSIFIED ADVERTISEMENTS

TENDERS INVITED

BOROUGH OF HARROW
Public Lighting
EDGWARE ROAD (TRUNK ROAD A5)

TENDERS are invited for the supply and installation of approximately 120, 200-watt Sodium lighting units at 30-ft mounting height on steel columns, including the removal of existing lighting installations, in Edgware Rd between Greenway Gdns, Hendon, and Canons Corner roundabout, Stanmore.

Plans and Conditions of Contract may be inspected at the office of the Borough Engineer, 48 Uxbridge Rd, Stanmore, Middlesex, from whom copies of the Form of Tender, Specification and Bill of Quantities are obtainable on payment of two pounds, by crossed cheque payable to the Harrow Corporation, and returnable where a bona-fide Tender reaches me in time.

Tenders on prescribed forms, enclosed in a plain envelope, bearing no indication of the sender, and endorsed "Tender for Lighting Equipment, Edgware Rd," must reach my office not later than 10 a.m. on Tuesday, 1 Nov., 1960.

The Corporation does not bind itself to accept the lowest, or any, Tender.

D. H. PRITCHARD,
Town Clerk.

Harrow Weald Lodge,
Harrow,
Middx. (S 334)

APPOINTMENTS VACANT

KENT COUNTY COUNCIL

REQUIRE an ELECTRICAL ENGINEERING ASSISTANT at a salary not exceeding £1,145 a year. Applicants should have experience in the design of electrical installations in buildings. Scale and starting salary dependent on qualifications and experience. Further details and application forms from the County Architect, Springfield, Maidstone. Closing date: 2 Nov., 1960. (S 335)

CENTRAL ELECTRICITY GENERATING BOARD
Eastern Division

APPLICATIONS are invited for the following appointment:

ASSISTANT ENGINEER
(EFFICIENCY AND TESTING)
GOLDINGTON GENERATING STATION
(BEDFORD)

Salary, N.J.B., Class H, Grade 7, Scale 10, £1,190/£1,325 per annum.

Applicants should possess the Higher National Certificate in Mechanical and/or Electrical Engineering or other equivalent qualifications and have had previous experience in a large modern Generating Station.

The successful applicant will be required to assist in the efficient and economical operation of the generating plant, the preparation of statistics and the keeping of technical records.

Applications, quoting reference Staff Vacancy No. 1387, stating age, experience and present position, should be sent to the Controller, Central Electricity Generating Board, Eastern Division, West Farm Pl, Chalk La, Cockfosters, Barnet, Herts., to arrive not later than 29 Oct., 1960. (S 333)

THE SOUTH WALES ELECTRICITY BOARD
COMMERCIAL ASSISTANT

APPLICATIONS are invited for the position of Commercial Assistant in the Barry District of the Cardiff and East Central Area.

Salary: N.J.B. Class F, Grade 7, Scale 8 (£1,040/£1,165 per annum).

The duties of this post will be of a general nature and preference will be given to Engineers possessing a Higher National Certificate in Electrical Engineering.

Applications stating age, present position, present salary, qualifications and experience should be addressed to C. L. Townsend, ASSOCIATE I.E.E., Manager, Cardiff and East Central Area, 445-447 Cowbridge Rd East, Cardiff, to arrive not later than 5 Nov., 1960.

Please quote reference 194/60/ET, endorsing envelope "Commercial Assistant."

R. G. WILLIAMS,
Secretary.
(S 332)

EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments. The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Essex Sub-Area
FOURTH ASSISTANT ENGINEERS
(a) CHELMSFORD DISTRICT
(TWO POSTS)
274/60.R.
(b) SOUTHEND DISTRICT
273/60.R.

Candidates should have had a sound technical training and suitable experience in the construction, operation and maintenance of H.V. and L.V. overhead and underground distribution systems, including substations.

Salary: N.J.B. (a) Class F, Grade 11 (£765/£870); (b) Class H, Grade 11 (£890/£1,015).

Apply by letter by 4 Nov., 1960, as follows:

(a) D. H. Walker, A.M.I.E.E., Manager, Eastern Electricity Board, Anchor St, Chelmsford, Essex.

(b) J. Linton, A.H.W.C., M.I.E.E., A.I.MECH.E., Manager, Southend-on-Sea District, Eastern Electricity Board, 85 London Rd, Southend-on-Sea, Essex.

Northmet Sub-Area
EDMONTON DISTRICT
DISTRICT COMMERCIAL ASSISTANT
(Ref. 997)
272/60.R.

Candidates should be fully experienced in modern installation practice, able to prepare specifications and competitive quotations and be competent to design thermal storage heating schemes, particularly floor-warming. A sound knowledge of the tariffs and their application, including supply by special agreement, is necessary.

Salary: N.J.C. Grade 3 (£780/£880) plus London Allowance.

Apply by letter to C. A. Baker, B.SC.(ENG.)LOND., M.I.E.E., Manager, Eastern Electricity Board, 305 Fore St, Edmonton, N.9, by 31 Oct., 1960. (S 338)

CENTRAL ELECTRICITY GENERATING BOARD
Midlands Division
THIRD ASSISTANT ENGINEER (CONTROL)

REQUIRED for shift duties at the Birmingham Grid Control Centre. N.J.B. service conditions, superannuable appointment, salary within Schedule B, Class CX, Grade 8, Scale 12, £1,105/£1,500 per annum, plus 10% shift allowance.

Applicants should have received a sound education and basic training, with subsequent experience in the electricity supply industry, preferably in power stations. H.N.C. or equivalent qualifications essential. Successful applicants will be required to assist the Control Engineer in all functions necessary for the proper control of a large portion of the grid system.

Apply, quoting vacancy number 277/60MD, on form AE6, available from the System Operation Engineer, Warwick Hse, Redhill Rd, West Heath, Birmingham 31. Closing date for receipt of applications: 31 Oct., 1960. (S 324)

CENTRAL ELECTRICITY GENERATING BOARD
South Wales Division

APPLICATIONS are invited for the following superannuable N.J.B. appointments in the South Wales Division:

ASSISTANT ENGINEER (INSTRUMENTS)
USKMOUTH "A" POWER STATION
WEST NASH, Nr. NEWPORT, MON
Vacancy No. 270/ET/60.

Salary: Schedule A, Class K, Grade 8, Scale 11 (£1,275/£1,410 per annum).

Applicants should possess H.N.C., or equivalent qualifications, and have experience in the maintenance of Power Station instruments, including the latest automatic boiler control techniques.

Closing date: 29 Oct., 1960.

ASSISTANT MAINTENANCE ENGINEER
(ELECTRICAL)
CARMARTHEN BAY POWER STATION
Vacancy No. 271/ET/60.

Salary: Schedule A, Class K, Grade 8, Scale 11 (£1,275/£1,410 per annum).

Applicants should have experience in the maintenance of modern Power Station equipment and will be required to carry out practical and planning office duties.
H.N.C. or equivalent qualifications.

STATION SHIFT CONTROL ENGINEER
LLYNFI POWER STATION
Nr. BRIDGEND, GLAM
Vacancy No. 272/ET/60.
RE-ADVERTISEMENT

Salary: Schedule A, Class G, Grade 10, Scale 6 (£890/£1,015 per annum) plus 10% shift enhancement.

Applicants should possess H.N.C. or equivalent qualifications and have had experience in a modern Power Station.
Previous applicants need not re-apply.

ASSISTANT ENGINEER (CO-ORDINATING)
USKMOUTH "A" POWER STATION
WEST NASH, Nr. NEWPORT, MON
Vacancy No. 273/ET/60.

Salary: Schedule A, Class K, Grade 10, Scale 9 (£1,115/£1,245 per annum).

Applicants should possess an appropriate engineering qualification and be able to organise and undertake job training and instruction of Power Station personnel. The successful applicant will be required to organise civil defence, fire fighting, etc., and be responsible for promotion of safety schemes, collection of data, compilation of records, etc., and the supervision of apprentices and general assistance. He will also conduct any special investigations required by the Station Superintendent and Deputy Station Superintendent and will carry out duties under the general direction of the Deputy Station Superintendent.

Special application forms obtainable from Secretary, South Wales Division, Central Electricity Generating Board, Twyn-y-fedwen Rd, Gabalfa, Cardiff, to be returned by 4 Nov., 1960. (S 337)

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 40s. per inch, and all other classified advertisements at 3s. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

SYSTEM CONTROL ENGINEER

REQUIRED in the Board's No. 4 Sub-Area, based on the Control Centre at Legacy, near Wrexham.

Salary within range £1,190/£1,325 per annum (N.J.B. Scale 10), plus 10% Shift Enhancement.

Duties, which will be on a shift basis, will be those normally associated with the control of switching operations on extensive networks covering eight districts, and the co-ordination of the loadings on the 33 kV network, which interconnects numerous 132/33 kV injection points.

Applicants should have had operational experience in distribution work and in substations. Appropriate technical qualifications an advantage.

Appointment subject to medical examination. Pension Scheme.

Application forms obtainable from the Manager, No. 4 Sub-Area, Electricity Hse, Rhostyllen, nr. Wrexham. Closing date: 4 Nov., 1960. (S 345)

SOUTHERN ELECTRICITY BOARD

THIRD ASSISTANT ENGINEER (PLANNING)

SUB-AREA Office of No. 2 (Newbury) Sub-Area. Salary: N.J.B., Class M, Grade 10 (£1,275/£1,410 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist in the Planning Section principally on the detailed planning of, and scheduling of equipment for, major substations. Applicants should possess suitable technical qualifications.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Rd, Newbury, Berks, and returned to him, quoting Z.1266, not later than 31 Oct., 1960.

ASSISTANT ENGINEER
(SUBSTATION MAINTENANCE)

Portsmouth District of No. 3 (Portsmouth) Sub-Area. Salary: N.J.B., Class J, Grade 7 (£1,275/£1,410 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist with the maintenance of plant and equipment at outdoor and indoor Substations on both urban and rural systems. Candidates should have had a good technical training, experience of the testing and maintenance of plant and equipment and should possess suitable technical qualifications. The appointment will involve standby duties.

Applications on forms obtainable from the Sub-Area Secretary, Lower Drayton La, Cosham, Portsmouth, and returned to him, quoting Z.1263, not later than 31 Oct., 1960.

ASSISTANT ENGINEER
(SUBSTATION MAINTENANCE)

Melksham District of No. 2 (Newbury) Sub-Area. Salary: N.J.B., Class G, Grade 7 (£1,115/£1,245 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist with the maintenance of plant and equipment at outdoor and indoor Substations on both urban and rural systems and to undertake standby duties. Candidates should have had a good technical training, experience of the testing and maintenance of plant and equipment and should possess suitable technical qualifications.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Rd, Newbury, Berks, and returned to him, quoting Z.1264, not later than 31 Oct., 1960.

ASSISTANT ENGINEER
(MAINTENANCE AND OPERATION)

Heston District of No. 1 (Southall) Sub-Area. Salary: N.J.B., Class G, Grade 9, (£1,015/£1,140 per annum inclusive of London Allowance). N.J.B. Conditions of Service.

The duties of the post will be to assist with the maintenance and operation of switchgear, transformers, auxiliary gear and underground cables up to and including 11 kV. The appointment will involve standby duties. Rented housing accommodation may be made available.

Applications on forms obtainable from the Sub-Area Secretary, 2-6 Windmill La,

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Southall, Middlesex, and returned to him, quoting Z.1197, not later than 31 Oct., 1960.

ASSISTANT ENGINEER (PLANNING)

Basingstoke District of No. 3 (Portsmouth) Sub-Area. Salary: N.J.B., Class F, Grade 11 (£765/£870 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist in the preparation of schemes and estimates for extensions of and reinforcement to overhead and underground H.V. and L.V. networks and to undertake standby duties if required. Suitable technical qualifications are necessary.

Applications on forms obtainable from the Sub-Area Secretary, Lower Drayton La, Cosham, Portsmouth, and returned to him, quoting Z.1228, not later than 31 Oct., 1960.

GENERAL ASSISTANT ENGINEER

Salisbury District of No. 4 (Bournemouth) Sub-Area. Salary: N.J.B., Class F, Grade 11 (£765/£870 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist with distribution including minor construction work and general maintenance of H.V. and L.V. overhead and underground distribution systems, substation plant, etc. The possession of a suitable technical qualification will be an advantage. The successful candidate will be required to carry out standby duties if and when called upon to do so.

Applications on forms obtainable from the Sub-Area Secretary, 1 Priory Rd, Bournemouth, and returned to him, quoting Z.1245, not later than 31 Oct., 1960.

The successful candidates for the above appointments will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible. (S 336)

GOVERNMENT OF SIERRA LEONE

TELECOMMUNICATIONS ENGINEER
POSTS AND TELECOMMUNICATIONS DEPARTMENT

RESPONSIBLE for supervising, maintaining, installing and developing telecommunications services generally including carrier telephony under the direction of the Postmaster-General and the Engineer-in-Chief.

Contract appointment. Salary range: £1,470/£2,145 a year. Gratuity 15% of salary. Free passages. Rented quarters. Children's allowances. Generous leave. Candidates under 45 years should be either A.M.I.E.E. or hold a Degree or Diploma in Electrical Engineering with Telecommunications subjects. They must have a sound knowledge of theory and practical experience of telecommunications engineering generally.

Write Director of Recruitment, Colonial Office, London S.W.1, giving full names, age, qualifications and experience, quoting BCD 108/15/03/D10. (S 323)

SOUTH WESTERN ELECTRICITY BOARD

Vacancies for

DISTRICT COMMERCIAL ENGINEER
WESTON

SECOND ASSISTANT ENGINEER
(TECHNICAL PLANT AND METERS)
CHIEF ENGINEER'S DEPARTMENT
HEAD OFFICE, BRISTOL

THIRD ASSISTANT ENGINEER (PLANNING)
CORNWALL GROUP, POOL, CORNWALL

Closing date for receipt of completed applications is Friday, 4th November, 1960

DISTRICT COMMERCIAL ENGINEER
WESTON

SALARY according to Class G, Grade 3, Salary Scale 13, £1,440/£1,610 per annum, of the N.J.B. Agreement.

The successful candidate will be responsible to the District Manager for the organisation and control of all commercial activities within the District in accordance with the Board's Commercial Policy.

Applicants should have wide experience on the commercial side of an Electricity Supply Undertaking and possession of appropriate qualifications at least equivalent to the Higher National Certificate in Electrical Engineering is necessary.

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Applications to be made on standard Form AE6/ACT, obtainable by postcard only from the District Manager, South Western Electricity Board, 168 Locking Rd, Weston-super-Mare, Somerset.

SECOND ASSISTANT ENGINEER
(TECHNICAL PLANT AND METERS)
CHIEF ENGINEER'S DEPARTMENT
HEAD OFFICE, BRISTOL

Salary according to Class AX, Grade 5, Salary Scale 13, £1,375/£1,610 per annum, of the N.J.B. Agreement.

Duties will include the preparation of specifications for and the examination of the performance of all types of distribution equipment, development of new techniques, and the solution of problems associated with protection, metering and light current practices.

Candidates should have had a sound technical and practical training, have comprehensive experience in the operation and maintenance of distribution systems up to and including 33 kV, and should possess as a minimum qualification the Higher National Certificate in Electrical Engineering or equivalent qualifications.

Applications to be made on standard Form AE6/ACT obtainable by postcard only from the Establishments Officer, South Western Electricity Board, Electricity Hse, Colston Ave, Bristol 1.

THIRD ASSISTANT ENGINEER (PLANNING)
CORNWALL GROUP, POOL, CORNWALL

Salary according to Class J, Grade 9, Salary Scale 9, £1,115/£1,245 per annum, of the N.J.B. Agreement.

The person appointed will be required to assist in the planning and preparation of schemes, and reports for immediate and long term proposals for the extension and reinforcement of overhead and underground distribution systems up to and including 33 kV. The duties will include load flow and fault level calculations, estimates of load growth and work on Capital Budgets and Costing.

Experience of planning, construction and operation of overhead and underground systems up to 33 kV is required. Qualifications leading to membership of the Institution of Electrical Engineers are desirable.

Applications to be made on standard Form AE6/ACT obtainable by postcard only from the Group Administrative Officer, South Western Electricity Board, Pool, Redruth, Cornwall. (S 346)

ELECTRICITY SUPPLY BOARD

(Dublin)

VACANCIES FOR TECHNICAL ASSISTANTS
(INSTRUMENTATION)

THE City and Guilds (London) Intermediate or Ordinary Grade Certificate in Instrument Maintenance or an equivalent technical qualification and suitable experience of servicing instruments in generating stations are essential qualifications.

Salary (within an incremental scale) will be commensurate with qualifications and experience and there are promotional prospects for highly qualified candidates. A contributory superannuation scheme also applies. The Board will contribute towards the travelling expenses of candidates resident in Great Britain who are required to attend for interview in Dublin.

The headquarters for these positions will be in Dublin, but the successful applicants will be required to travel to, and spend short periods in, the Board's provincial generating stations (travelling and subsistence allowances are provided on such occasions).

Applications, which should give age and details of education, must set out clearly applicant's qualifications and experience and should be forwarded immediately to the Personnel Officer, Electricity Supply Board, 27 Lower Fitzwilliam St, Dublin.

J. G. GARGAN,
Secretary.
(S 328)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2

LONDON ELECTRICITY BOARD

ASSISTANT DISTRIBUTION ENGINEER

APPLICATIONS are invited for the above position in the Board's West End District at 25 Eccleston Pl, S.W.1.

Applicants should have had a sound technical education to the standard of the Higher National Certificate, and possess practical experience in all branches of engineering work associated with the organisation of a District distribution department.

The post is graded under Schedule A of the National Joint Board Agreement as Class K, Grade 11, £1,090 per annum rising to £1,215 per annum, inclusive of London Allowance.

Applications should be sent direct to the District Manager at the above address, to arrive within 14 days of the publication date of this notice. Please quote ref.: PER/V/3081/T. (S 347)

CENTRAL ELECTRICITY GENERATING BOARD

South Western Division

ASSISTANT ENGINEERS (OPERATION)

Vacancy No. ET/143/60.

REQUIRED at Hinkley Point Nuclear Power Station.

Superannuation Scheme. Salary: N.J.B., provisionally within Scale 11. £1,275/£1,410 per annum.

Following a short period of theoretical training, successful candidates will, initially, be employed upon certain aspects of plant inspection and will ultimately be responsible for the operation on shift of a reactor and its associated generating plant. These positions will give excellent experience for Engineers wishing to make their career in Nuclear Power Stations.

Previous applicants need not apply.

Applications on Form A.E.6/ACT obtainable from the Divisional Secretary, 26 Oakfield Rd, Bristol 8, should be completed and returned by 31 Oct., 1960. (S 340)

CENTRAL ELECTRICITY GENERATING BOARD

East Midlands Division

ASSISTANT SHIFT CHARGE ENGINEER
LEICESTER POWER STATION

Vacancy No. 232/60.

APPLICATIONS are invited for the position of Assistant Shift Charge Engineer at Leicester Power Station, Rawdykes Rd, Leicester.

Applicants should have received a sound technical training and have had experience in a modern power station. Preference will be given to candidates who possess the Higher National Certificate or its equivalent.

Salary will be in accordance with Class G, Grade 9 (£965/£1,090 per annum) of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 29 Oct., 1960.

ASSISTANT MAINTENANCE ENGINEER (MECHANICAL)
LEICESTER POWER STATION

Vacancy No. 233/60.

Applications are invited for the position of Assistant Maintenance Engineer (Mechanical) at Leicester Power Station, Rawdykes Rd, Leicester.

Applicants should have served a recognised apprenticeship in mechanical engineering. Preference will be given to candidates who possess technical qualifications to Higher National Standard.

Salary will be in accordance with Class G, Grade 8 (£1,040/£1,165 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications: 29 Oct., 1960.

STATION SHIFT CONTROL ENGINEER
WARWICK POWER STATION

Vacancy No. 237/60.

Applications are invited for the position of Station Shift Control Engineer at Warwick Power Station, Emscote Rd, Warwick.

Candidates should be suitably qualified and have had experience in the control room.

Salary will be in accordance with Class E, Grade 10 (£765/£870 per annum) of the National Joint Board Agreement, plus £90 per annum allowance for shift duties.

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Closing date for receipt of applications: 29 Oct., 1960.

ASSISTANT SHIFT CHARGE ENGINEER
CASTLE DONINGTON POWER STATION

Vacancy No. 240/60.

Applications are invited for the position of Assistant Shift Charge Engineer at Castle Donington Power Station, nr. Derby.

Candidates should have received a thorough practical and technical training and have had experience in the operation of modern high merit plant, together with the control of staff.

Technical qualifications leading to Corporate Membership of a professional institution will be an added advantage.

Salary will be within Class L, Grade 8 (£1,350/£1,500 per annum) of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 5 Nov., 1960.

These appointments will be pensionable within the terms and conditions of the Electricity Supply (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT which may be obtained from the Station Superintendent and should be returned to him by the date stated.

O. S. WOODS,
Divisional Controller.
13 Oct., 1960. (S 344)

BRADFORD INSTITUTE OF TECHNOLOGY

Department of Electricity Engineering

APPLICATIONS are invited for the following posts in this rapidly expanding department which offers exceptional opportunities for teaching, consulting and research work:

SENIOR LECTURER IN ELECTRICAL ENGINEERING

Salary scale: £1,550/£1,750.

LECTURER IN ELECTRICAL ENGINEERING

Salary scale: £1,370/£1,550.

Candidates should be suitably qualified to teach to final degree standard in electrical power and machines or electronics and telecommunications. Industrial and research experience will be a recommendation.

The successful candidates will be encouraged to develop industrial contacts and undertake research for which adequate facilities will be available.

Previous industrial and research experience at a suitable level will be taken into account in fixing the commencing salary.

Further particulars and forms of application may be obtained from the Registrar, Bradford Institute of Technology, Bradford 7.

HENRY PATTEN,
Clerk to the Governors.
(S 327)

THE NORWICH CITY COLLEGE AND ART SCHOOL

Ipswich Road, Norwich, Norfolk NOR 67 D.

Principal: Frank Briers, B.SC., D.PHIL.(OXON), F.R.I.C.

Wanted

ASSISTANT LECTURER, GRADE B

IN Electrical Engineering, to commence duties on 1 Jan., 1961. Candidates should hold the Higher National Certificate in Electrical Engineering or equivalent qualification and should have had some industrial experience. Duties will include teaching in the Ordinary National Certificate courses, and in the City and Guilds Electrical Installation and Electrical Fitters' courses. There is opportunity for more advanced work.

Burnham Technical Scale salary, Grade B (£700 x £27 10s—£1,150, plus appropriate allowances).

Application forms, obtainable from the Director of Education, City Hall, Norwich, NOR 01 A, on receipt of a stamped addressed envelope, should be sent to the Principal as soon as possible. (S 365)

MIDLANDS ELECTRICITY BOARD

SENIOR SALES REPRESENTATIVE (AGRICULTURAL)

REQUIRED in the Shrewsbury District of the Shropshire and Herefordshire Sub-Area.

Candidates should have had extensive experience of rural development and sales, and be fully conversant with all domestic uses. Must have a sound knowledge of and be able to advise upon the use of electricity in farming and horticulture. Be able to discuss intelligently relevant farming matters and practice and be prepared to give talks to local agricultural and horticultural associations.

The possession of a driving licence is essential and the ability to estimate for installation work and the possession of technical qualifications would be an advantage.

Salary: £780/£880 per annum (N.J.C. Grade 3). Superannuable.

Apply, by letter, stating age, experience and present position, to Mr W. Winwood, Sub-Area Manager, Midlands Electricity Board, Spring Gdns, Ditherington, Shrewsbury.

F. W. CATER,
Secretary.
(S 322)

THE NORTH WESTERN ELECTRICITY BOARD

THIRD ASSISTANT ENGINEER
SUB-AREA ENGINEERING DEPARTMENT
CLAYTON TESTING STATION

APPLICANTS should have a wide experience in the testing of all types of protective equipment including associated control and other gear. Experience in high voltage testing would be an advantage.

Preference will be given to applicants who are Associate Members of the Institution of Electrical Engineers.

Salary Scale: £1,190/£1,325 p.a. Grade L.10. N.J.B. Conditions.

SECOND ASSISTANT DISTRICT ENGINEER
BLACKBURN DISTRICT

The duties include assisting in the operation, maintenance and construction of underground and overhead mains, substations and transformers, and to undertake standby duties. Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary scale: £1,275/£1,410 p.a. Grade J.7. N.J.B. Conditions.

Applications on forms to be obtained from the Manager, No. 5 Sub-Area, The North Western Electricity Board, Jubilee St, Blackburn, and returned to him by 31 Oct., 1960. (S 326)

CENTRAL ELECTRICITY GENERATING BOARD

East Midlands Division

RESIDENT ENGINEER (CIVIL WORKS)
TRANSMISSION DEPARTMENT
DIVISIONAL HEADQUARTERS

Vacancy No. 238/60.

A VACANCY exists for a Resident Engineer to supervise the Headquarters works of the Central Electricity Generating Board in the East Midlands Division. The successful applicant will be located at Nottingham and will be responsible to the Chief Transmission Project Engineer at Headquarters for the supervision of contractors in the construction of civil works associated with 275 kV and 132 kV substations.

Applicants should have a wide experience of civil and building works, including reinforced concrete structures.

Applicants should be Corporate Members of the Institution of Civil Engineers.

The salary will be in accordance with Grade BX5, Scale 14 (£1,535/£1,720 per annum) of the National Joint Board Agreement, and the position will be pensionable within the terms and conditions of the Electricity Supply (Staff) Superannuation Scheme.

Applications should be addressed to O. S. Woods, Esq., Divisional Controller, East Midlands Division, P.O. Box 25, Barker Gate, Nottingham, to arrive not later than 25 Nov., 1960.

O. S. WOODS,
Divisional Controller.
6 Oct., 1960. (S 343)

ADEN GOVERNMENT

Electricity Department

ASSISTANT CONSUMERS' ENGINEER

REQUIRED on contract for one tour of 18/24 months in first instance.

Commencing salary according to age and experience in scale (including Pay Differential) rising to £1,579 a year. Supplementary allowance £144/£120 a year. Gratuity at rate of 12½% of total salary drawn. Free passages. Outfit allowance £60.

Secondment from a Home Area Board may be possible in certain circumstances.

Candidates should possess H.N.C. in Electrical Engineering or equivalent and have had technical training and experience in utilisation of electrical energy in industrial, commercial and domestic premises.

Apply to Crown Agents, 4 Millbank, London S.W.1, for application form and further particulars, stating age, name, brief details of qualifications and experience and quoting reference M2A/51004/EE. (S 325)

SOUTH EASTERN ELECTRICITY BOARD

DISTRICT COMMERCIAL ENGINEER

SWALE DISTRICT AT SITTINGBOURNE

SALARY under N.J.B., Class F, Grade 3, Scale 12, £1,350/£1,500 p.a. with progression to Grade 2 (maximum salary £1,610) subject to satisfactory service. Superannuable. Duties will include the organisation and control of the Commercial Department which has a contracting section and three showrooms. The district has an area of 120 square miles and supplies approximately 27,000 consumers. Applicants should be conversant with tariff negotiations, sales activities, contracting and general load development, and should preferably be corporate members of the I.E.E.

Applications, quoting ET and naming two referees, to District Manager, Seeboard, 88A High St, Sittingbourne, Kent, by 2 Nov., 1960.

ASSISTANT DISTRICT ENGINEER

DORKING AND EPSOM DISTRICT

Applicants, who should be suitably qualified, should have received all-round training and experience in the engineering department of a district, covering planning, construction, operation and maintenance. The position will entail standby duties. This is an opportunity to gain valuable experience in an urban and rural distribution system.

Salary: £1,040/£1,165 per annum under N.J.B., Class F, Grade 7. Superannuable. Consideration will be given to private car allowance and assistance with regard to house purchase.

Applications, quoting ET and naming two referees, on forms from District Manager, Seeboard, 56 South St, Dorking, by 2 Nov., 1960.

GEORGE WRAY,
Secretary.
(S 342)

UGANDA ELECTRICITY BOARD

THE Board requires ASSISTANT ELECTRICAL ENGINEERS to participate in the interesting work of electrical development in the Protectorate.

Uganda has a very pleasant climate and income tax is lower than in the United Kingdom. Passages for employee and family, partly furnished accommodation, medical and dental treatment all free. Five days' overseas leave for every completed month of service in East Africa, plus local leave. Normal tours of duty 24-36 months.

Applicants should be corporate members of the Institution of Electrical Engineers or should have technical qualifications leading to that status.

Some experience in the construction and/or operation and maintenance of an electricity supply network, including overhead lines and substations with voltages up to 33 kV is essential. Experience at higher voltages is desirable.

Commencing salary depending upon qualifications and experience within the scale £1,265 x £35—£1,580 per annum. In addition, a monthly gratuity of 30% of salary will be paid.

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Persons serving in the United Kingdom Electricity Industry may be seconded to Uganda for periods of up to two years without loss of pension or other rights with the approval of their employing authority. Annual leave entitlement for seconded personnel is six weeks.

Application forms and further information on Uganda and the Uganda Electricity Board may be obtained from the London Representative, Uganda Electricity Board, Uganda Hse, Trafalgar Sq, London W.C.2, to whom completed forms should be returned not later than 14 Nov., 1960.

E. H. WILSON,
Secretary.
(S 341)

CORPORATION OF GLASGOW

Architectural and Planning Department

ASSISTANT ENGINEER (ELECTRICAL)

APPLICATIONS for the above, superannuable, appointment are invited from Graduates and Associate Members of the Institution of Electrical Engineers. Salary scale: £794/£1,385 with placing according to qualifications and experience. There is a point within the scale at which increments may be accelerated.

Form of application may be obtained from the Principal Administrative Officer, 20 Trongate, Glasgow C.1.

A. G. JURY,
City Architect and Director of Planning.
(S 339)

ASSISTANT ELECTRICAL ENGINEER required by National Newspaper. Age 23-28. Electrical apprenticeship and Higher National. Must be first class electrical draughtsman. Good prospects. Box No. 8041, Electrical Times. (S 316)

BRITISH Engine Boiler and Electrical Insurance Co. Ltd., Longridge Hse, Manchester 4. ELECTRICAL SURVEYORS required in Scotland, also Manchester. Permanent position carrying progressive salary scale, £800/£1,100, and non-contributory pension. Candidates aged 26 to 32, with H.N.C. in Electrical Engineering or Grad. I.E.E. and with apprenticeship in manufacture or repair of electrical machinery, are invited to apply stating age, qualifications and experience. (S 362)

YORKSHIRE

IMPERIAL METALS LIMITED

The Company wishes to appoint a

GRADUATE ELECTRICAL ENGINEER

between the age range 25-30. Candidates should have a sound electrical engineering training with subsequent experience of some of the following: Switchgear, motor control gear, rectifiers, and A.C. and D.C. motors.

Duties will be concerned with the design, construction, maintenance and instrumentation of a wide range of electrical equipment for the Company's largest and still expanding factory site at Leeds, with a maximum demand of 12 MVA.

The Company offers attractive conditions of employment together with a Pension and Life Assurance Scheme and a Profit Sharing Scheme.

Detailed applications, quoting present salary, should be marked "Electrical Engineer—Confidential" and addressed to the

Chief Personnel Officer,
YORKSHIRE IMPERIAL METALS LTD.
P.O. Box 166,
LEEDS.

(S 364)

IMPERIAL SMELTING CORPORATION LTD.

ASSISTANT ELECTRICAL ENGINEER SWANSEA VALE

Applications are invited from suitable qualified engineers aged 23-35 for the position of Assistant Electrical Engineer at the above Corporation's Swansea Works. The duties will involve assistance in the supervision and carrying out of electrical maintenance and repair work, installation of new equipment and advising on suitability of electrical equipment.

Candidates who are Graduate Members of the Institution of Electrical Engineers with three years' electrical supervisory experience will be considered, but a B.Sc. with five years' experience or Associate membership of the Institution of Electrical Engineers is desirable. ET/A.E.E.

ASSISTANT INSTRUMENT ENGINEER

A qualified engineer, preferably with professional qualifications, or University Degree in Physics, Electrical Engineering or Electronics, but a candidate with H.N.C. or similar qualification will be considered. Knowledge and experience of instrument maintenance and development is essential, preferably in the heavy chemical or metallurgical industry. ET/A.I.E.

Applications should be marked "Confidential" and submitted, with appropriate references, to:

Personnel Manager,
IMPERIAL SMELTING CORPORATION LTD.,
St. Andrew's Road,
AVONMOUTH

(S 348)

ESTIMATING/SUPERVISING ENGINEER required for Contractor's London Office. Applicants should have experience in preparation of tenders and setting out of work from design stage to completion. Write, stating age, experience, etc., and salary required to Phoenix Electrical Co. (London) Ltd., Phoenix Hse, 16-18 Marshalsea Rd, S.E.1. (S 353)

ELECTRICAL WHOLESALERS (15 miles N.W. of London) require Stores Manager. A good salary will be paid to applicant who should have thorough knowledge of the trade.—Box 8053, Electrical Times. (S 356)

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Please quote reference TR/ET/MJP.

(S 350)

ELECTRICAL DRAUGHTSMAN to take charge of small drawing office in works situated North London manufacturing distribution switchboards and general installation equipment. As the appointment would involve some work on the board it would probably suit a younger man with several years' recent experience as Designer Draughtsman, and who is looking for some added responsibility and an outlet for originality and initiative. Commencing salary not less than £900 p.a. with senior staff and pension benefits.—Box No. 8029, Electrical Times. (S 259)

ELECTRICAL ENGINEER SURVEYOR required by Cornhill Insurance Company Limited in the South East London-Kent area. Applicants must have Winding Shock experience and a technical education to H.N.C. or Grad. I.E.E. Salary commencing £800 per annum rising to £1,100 per annum. Pension Scheme. Reply, stating age and experience, to Chief Engineer, P.O. Box 10, 57 Ladymead, Guildford, Surrey. (S 366)

ELECTRICAL ENGINEER required for Glasgow Office staff, age 23-28. Applicants (H.N.C. minimum) should have had experience in the manufacture of electrical machines. Progressive salary with non-contributory pension. Applications stating age, nationality, qualifications and experience to British Engine Boiler and Electrical Insurance Co. Ltd., 98 West George St, Glasgow C.2. (S 361)

ELECTRICAL ENGINEER required by Tin Mining Company in Thailand; must be fully qualified certificated electrical engineer and conversant with installation and maintenance of heavy plant. Commencing salary from £1,540/£1,820 per annum according to qualifications and experience; marriage allowance £210 per annum; free furnished quarters and free medical attention provided; contracts of three years' duration with six months' leave on full pay and allowance between contracts; company pays for passages of employee and family; non-contributory pension scheme and contributory provident fund. Written applications with full particulars of age, education, qualifications and experience, married or single, and copies of testimonials to Box 019, c/o Walter Skinner Ltd., 20 Copthall Ave, London E.C.2. (S 360)

INSPECTION ENGINEER—ELECTRICAL—required by North East Firm. Applicants should be between 25 and 40 years of age and be prepared to travel. Minimum qualification O.N.C. and preferably with some inspecting experience. Please reply to Box No. 8051, Electrical Times, giving essential data and salary required. (S 355)

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(S 330)

INSPECTION ELECTRICAL ENGINEER required for London Area. Applicants should be between 25 and 40 years of age with minimum qualification O.N.C. and with inspection experience. Reply to Box No. 8049, Electrical Times, giving essential data and salary required. (S 354)

INSPECTION ELECTRICAL ENGINEER required for Manchester area. Applicants should be between 25 and 40 years of age with minimum qualification O.N.C. and with some inspection experience. Reply to Box No. 8047, Electrical Times, giving essential data and salary required. (S 352)

JUNIOR ELECTRICAL ENGINEER required as Assistant to the Chief Electrical Engineer of a large modern steel works in the Midlands. The appointment carries responsibility for technical development under the general guidance of the Chief Electrical Engineer and gives excellent opportunities for promotion. Candidates, preferably with experience in the heavy electrical field, should possess H.N.C. minimum or graduate standard qualifications.

Write, giving age, details of experience, qualifications and salary level expected to Box 8035, Electrical Times. (S 313)

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R. G. WILLIAMS,
Secretary.
(S 349)

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(S 315)

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for a permanent and pensionable appointment in Ghana. Candidates should be between 25 and 31 years of age, have served a recognised apprenticeship preferably in factory electrical maintenance, and have in addition a minimum of three years' practical experience.

They should also possess at least an Ordinary National Certificate (Electrical).

Please write with full particulars to: The Personnel Officer.

(S 351)

MERZ AND McLELLAN have vacancies in their Esher Office for Mechanical Engineering Draughtsmen. Preferred age limits 25 to 35. Applicants should be experienced in Plant Layout Work, preferably, but not essentially, in connection with Power Stations. Salaries will be fully appropriate to experience, rising from about £870 per annum at age 25. Excellent working conditions. Pension Scheme. Canteen. Apply in writing to Merz and McLellan, Milburn, Esher, Surrey. (S 359)

TECHNICIAN required to take charge of Cable Works Laboratory. Work involves chemical and physical testing of raw materials as well as components of Paper, Rubber or Plastic Cables. This position should appeal to a young man who wishes to supplement theoretical training with practical experience: knowledge of cable manufacture is desirable but not essential if other qualifications are good. Pension Scheme and canteen facilities. Apply to the Secretary, Britannic Cables Ltd., Iver, Bucks. (S 307)

ASSISTANT ELECTRICAL ENGINEER

for new construction work, aged 25-30. Applicants should have served an apprenticeship with a recognised firm of electrical manufacturers, have a Higher National Certificate in Electrical Engineering (Graduate I.E.E. preferred), a knowledge of a.c. and d.c. equipment used in steel works, cabling and distribution systems, and preferably some experience of contactor control gear. The successful candidate will be required to assist in the preparation of new schemes, specification of equipment and supervision of site work. The salary will be dependent on age and experience. Applications giving full details should be made in writing to the

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Steel, Peech and Tozer,
Branch of the
United Steel Companies Ltd.,
The Ickles, Rotherham.

(S 357)

BICC

In order to meet the demands of the rapidly expanding Accessories Division at our Prescot Works, we wish to fill the following posts:

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SENIOR DRAUGHTSMEN (Electrical and Mechanical)
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6. **Sub-station Panels and Street Distribution Pillars.**
7. **Electrical Connectors of all types.**

Previous experience in precisely these fields is not essential, but we wish to appoint men having initiative, a sense of responsibility and ability to advance in our Organisation.

Candidates should have served a recognised engineering apprenticeship or completed an alternative form of practical workshop training and must be qualified to at least O.N.C. standard.

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Applications to:

Works Personnel Officer, (Ref No. P.516)
B.I.C.C. LTD.
Prescot, LANCS.

(S 329)

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Electric Traction Engineer,
(London Area)
British Railways, Eastern Region,
off Ley Street,
Ilford, Essex.

(S 229)

SHIFT ELECTRICAL FOREMEN are required by Bowaters United Kingdom Pulp and Paper Mills Limited, Thames Division, Northfleet, Kent.

Applicants should have served a recognised apprenticeship and hold the Ordinary National Certificate in Electrical Engineering. Experience should include power engineering as encountered in a factory installation, H.T. and M.V. distribution, A.C. and D.C. motors, with their associated control systems.

A contributory superannuation fund is operated by the Company.

Applications should be sent to the Chief Engineer at the above address, giving full details of age, training and experience. (S 358)

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ADVERTISER seeks post with electrical firm, southern area. 30 years' electrical experience of all types of installations, measuring, ordering, records and office experience.—Box No. 8023, Electrical Times. (S 203)

MANAGER in complete charge of Electrical Contracting Business with turnover of £80,000, seeks similar post in S.W. London area.—Box No. 8021, Electrical Times. (S 202)

PATENTS

THE proprietor of British Patent No. 756681, entitled "IMPROVEMENTS IN OR RELATING TO ELECTRICAL THERMOSTATS" offers same for license or otherwise to ensure practical working in Gt. Britain. Inquiries to Singer, Stern and Carlberg, 140 So. Dearborn St, Chicago 3, Ill., U.S.A. (S 310)

THE proprietor of British Patent No. 753678, entitled "IMPROVEMENTS IN SNAP-ACTION ELECTRIC SWITCH," offers same for license or otherwise, to ensure its practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, Chrysler Building, New York 17, N.Y., U.S.A. (S 311)

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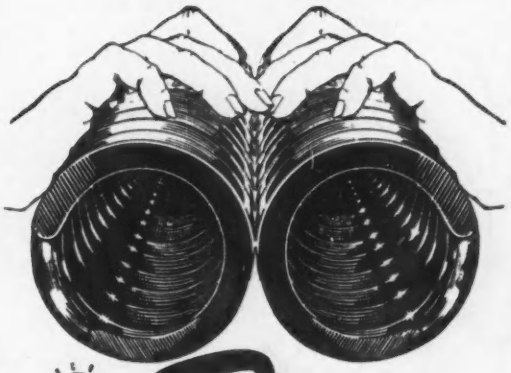

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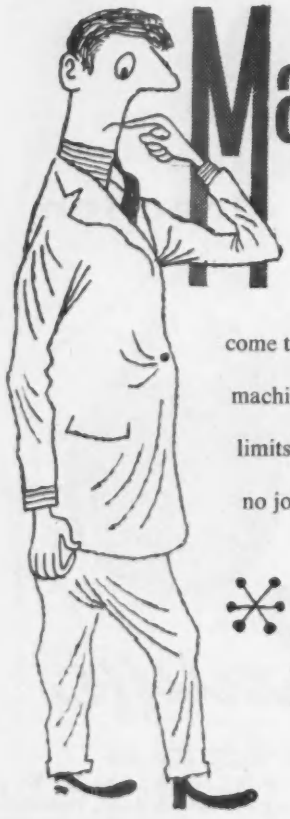

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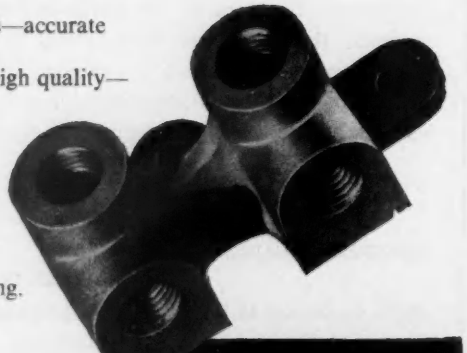

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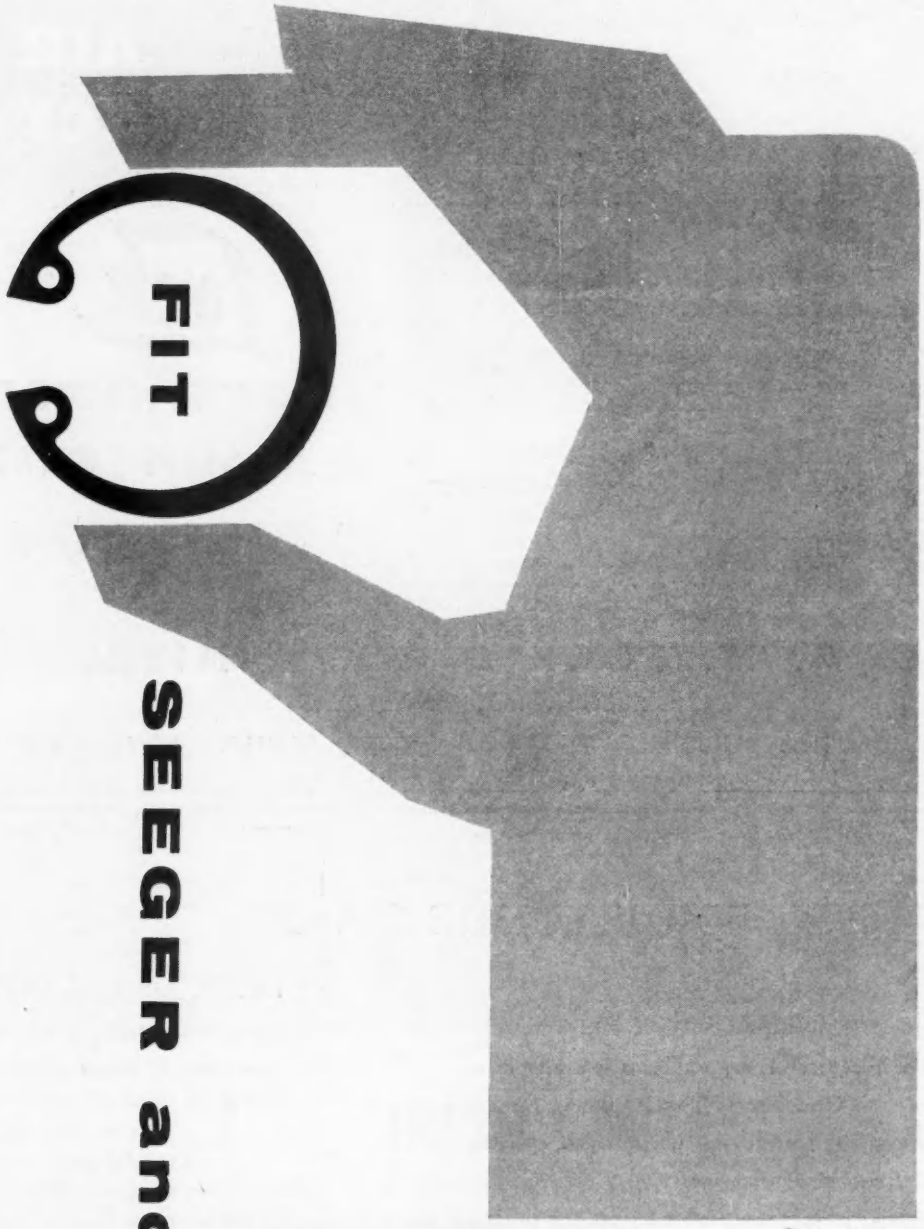

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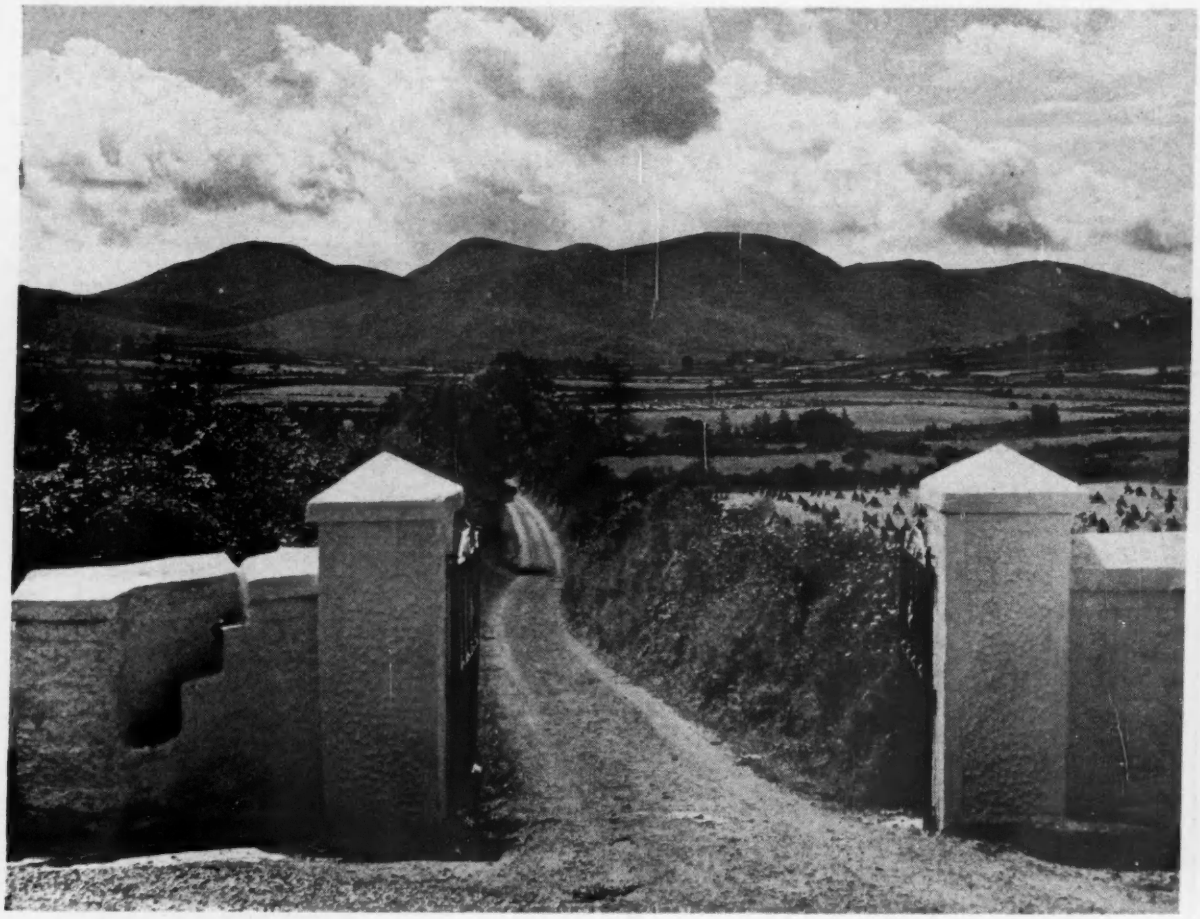

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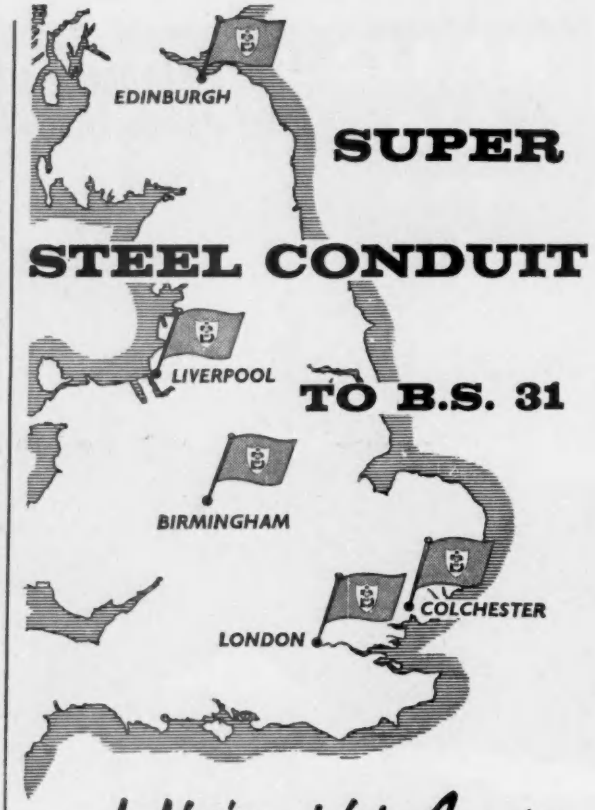

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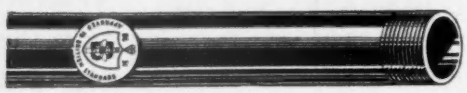

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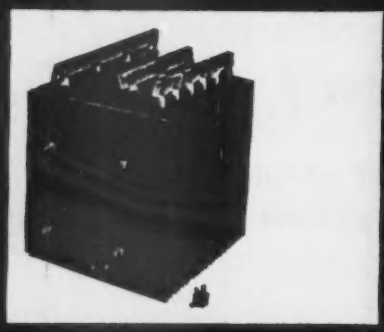

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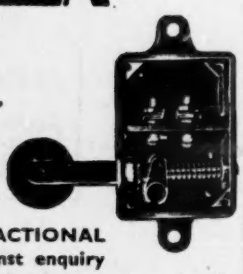

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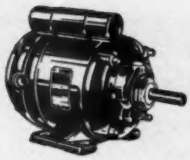

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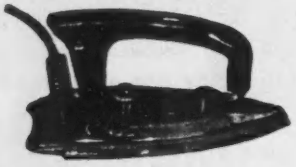

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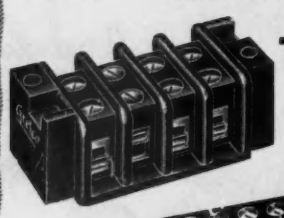

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The moulding illustrated is by Aldridge Plastics Ltd., using compound produced by B.I.P. Chemicals Ltd.

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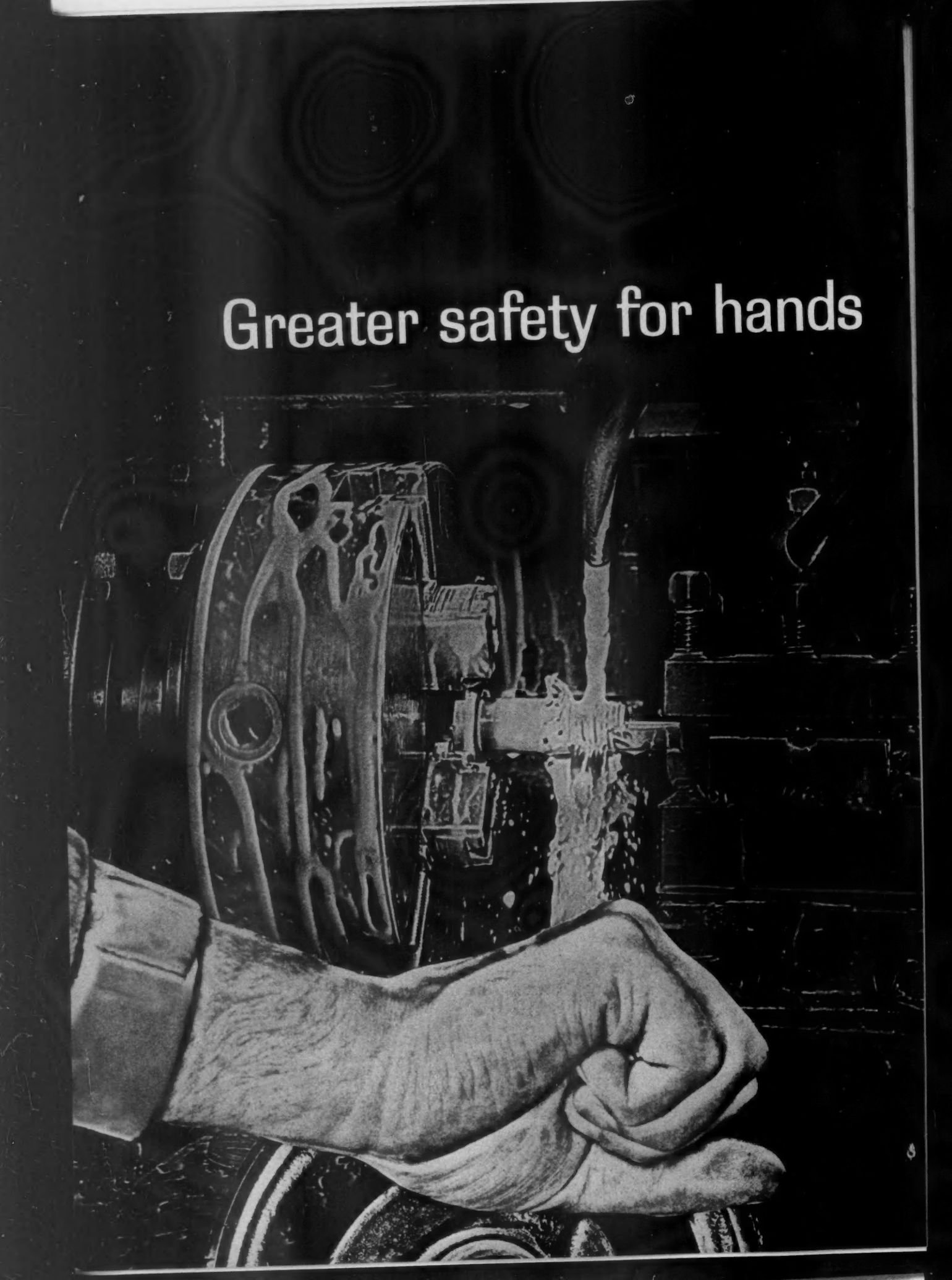


With new Shell Dromus Oils

Most modern soluble cutting oils contain phenolic compounds used as coupling agents between the oil and the emulsifier, for better blending and easier mixing. These phenolic compounds can cause skin irritation, especially where modern high-speed machines are used and the emulsion can concentrate, through the evaporation of water, above the safety level.

Shell research chemists have been working on this problem, which has been causing some concern to Management. After considerable research, Shell Dromus Oils have been reformulated and these new cutting oils now produce bland emulsions, which considerably reduce the risk of skin trouble to operators.

The real difficulty was to find a new coupling agent to replace the phenolic compounds, and Shell finally used what their chemists know as a higher fatty alcohol complex. This solved one problem, but presented another. The new coupling agent was volatile at the high temperatures normally used in blending processes. Further research found a solution to this problem by designing and installing new plant.

The new Dromus Oils are every bit as efficient as before and cost no more. They put Management in the welcome position of being able to minimise working hazards at no extra cost. And machine men need no longer be so worried about skin troubles.

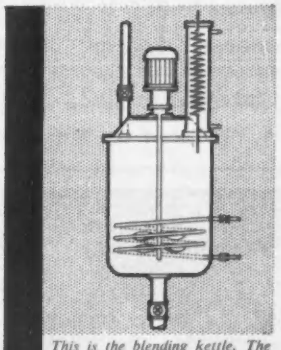
The moral of the story is that Shell research is supremely applicational. The centre at Thornton is always ready to work with even the most specialised sectors of industry to produce the right oil for the job. If you and your organization have any major lubricating problems, it pays to get in touch with your local supplier of Shell Industrial Lubricants.

The Research Story

Shell chemists in the U.K., in Holland and in the U.S.A., prepared and examined hundreds of experimental soluble oils, and established that certain combinations of fatty alcohols could be used in place of phenolic compounds with no loss of efficiency. They set to work to discover the best combination and developed a higher fatty alcohol complex which fitted exactly. Then they realised that to blend this new coupling agent into soluble oils would require special plant and new blending techniques.

Exhaustive testing of blend stability, emulsion stability, anti-corrosion and machining properties led to selection of the most promising blends. A pilot plant was set up to produce batches of these for use in field trials.

This field testing and final development proceeded for two years whilst production plants were erected at points so chosen as to give the most economical and rapid delivery throughout the United Kingdom.



This is the blending kettle. The reflux condenser beside the stirrer motor prevents the loss of constituents volatile at the blending temperature.

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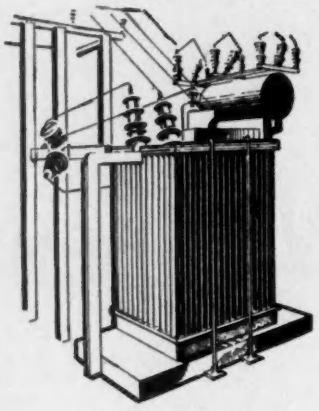

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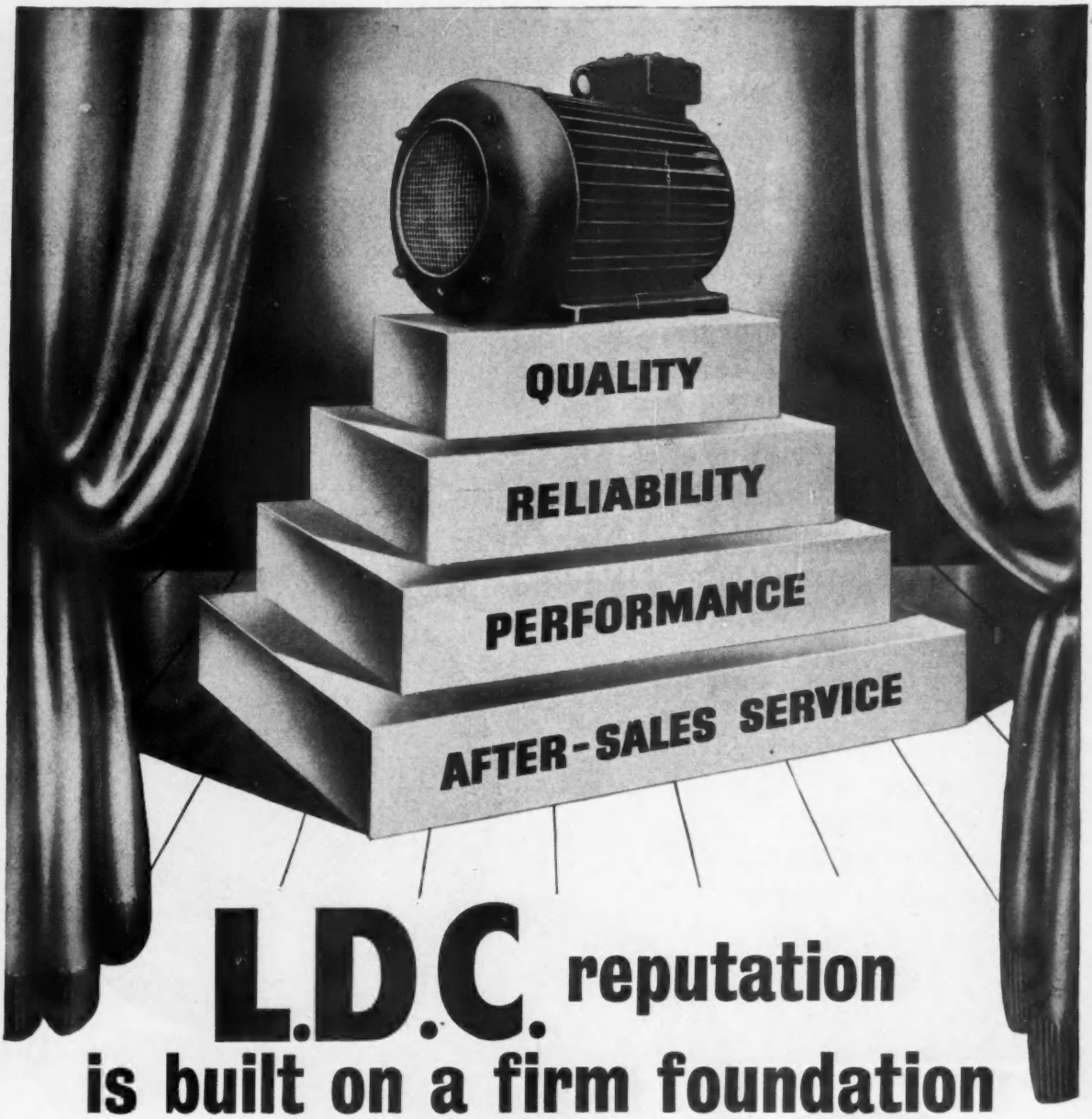

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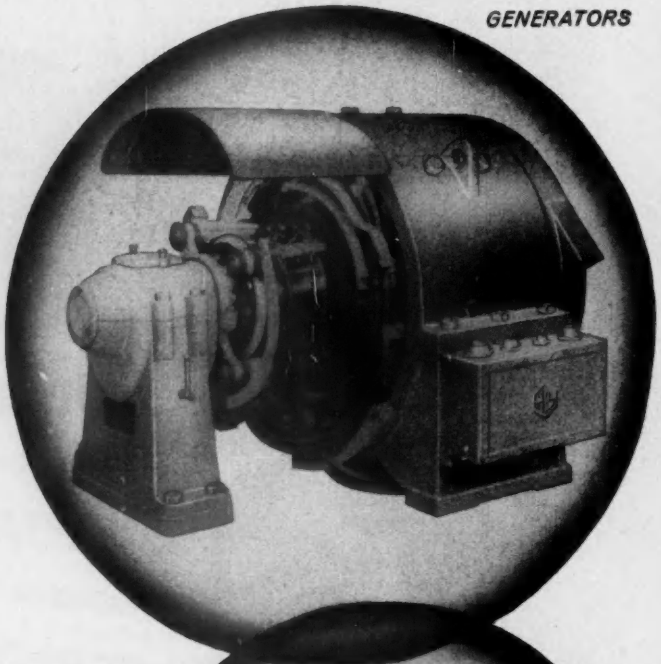

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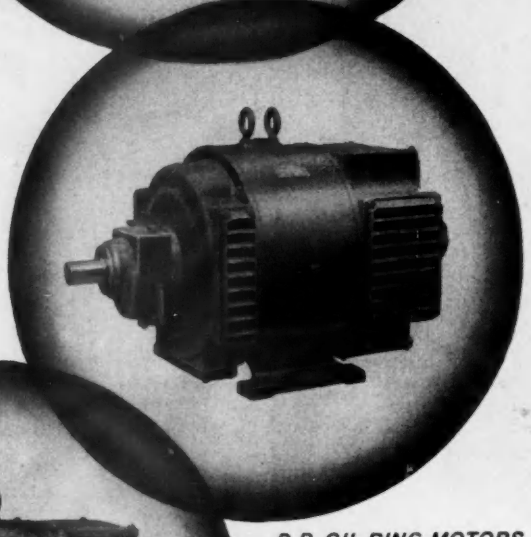

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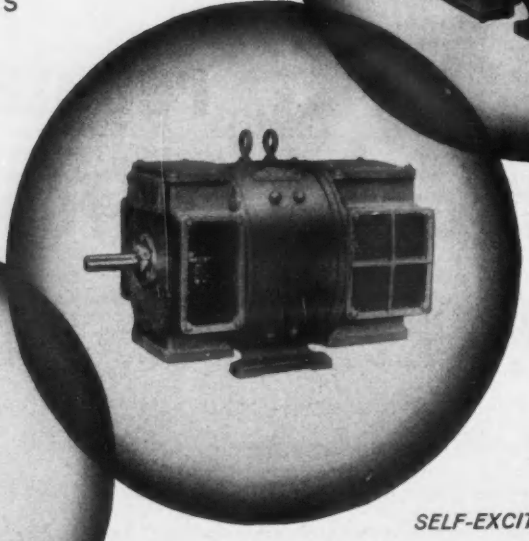

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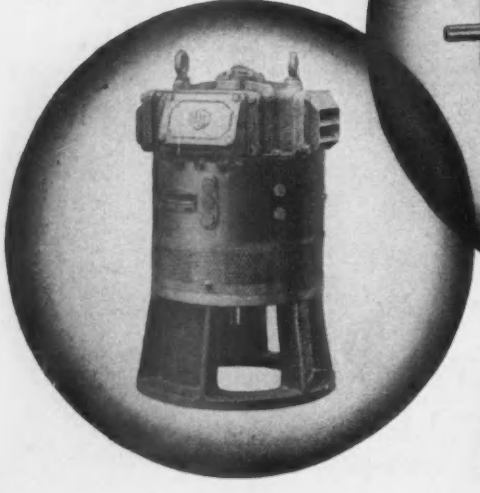

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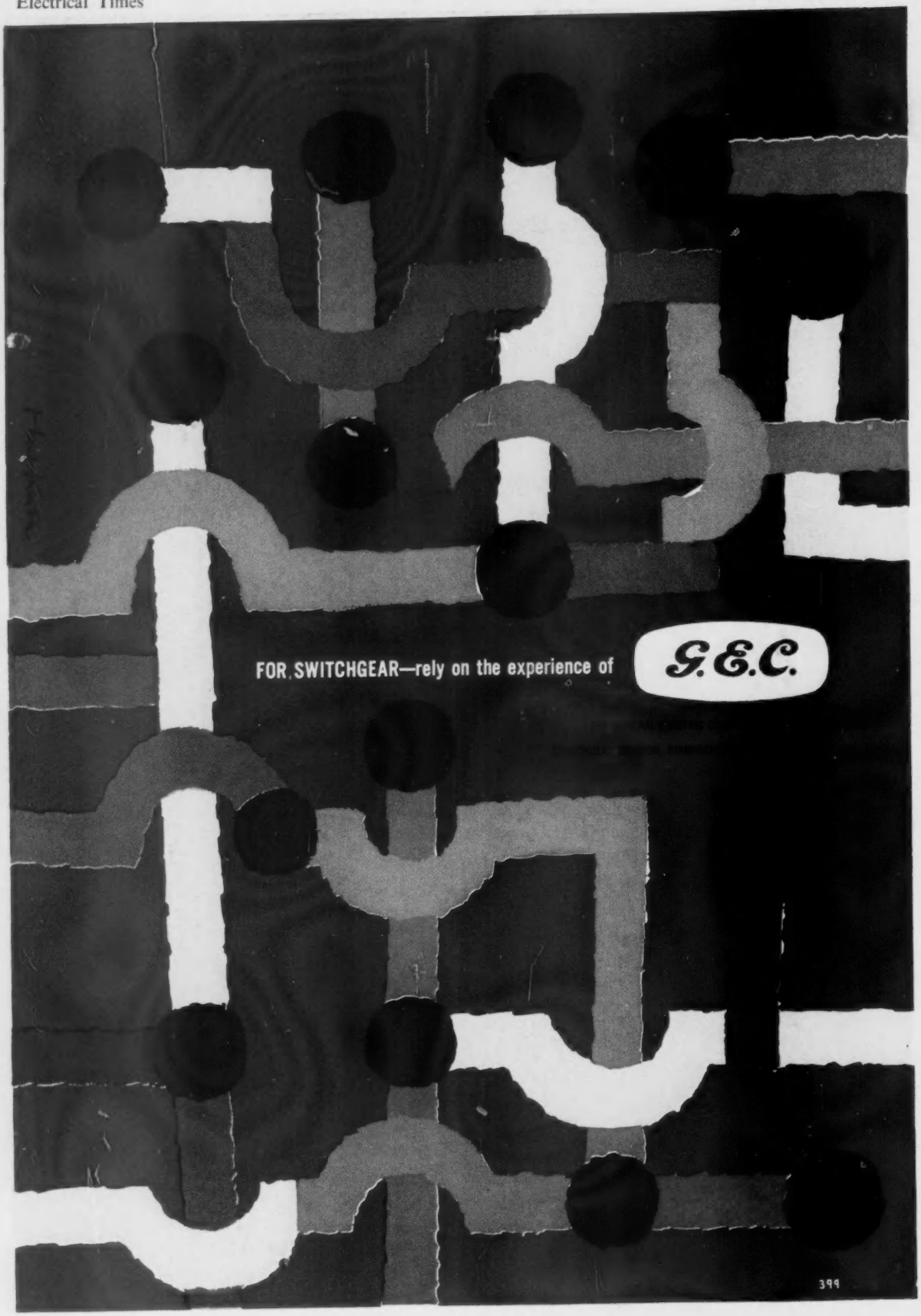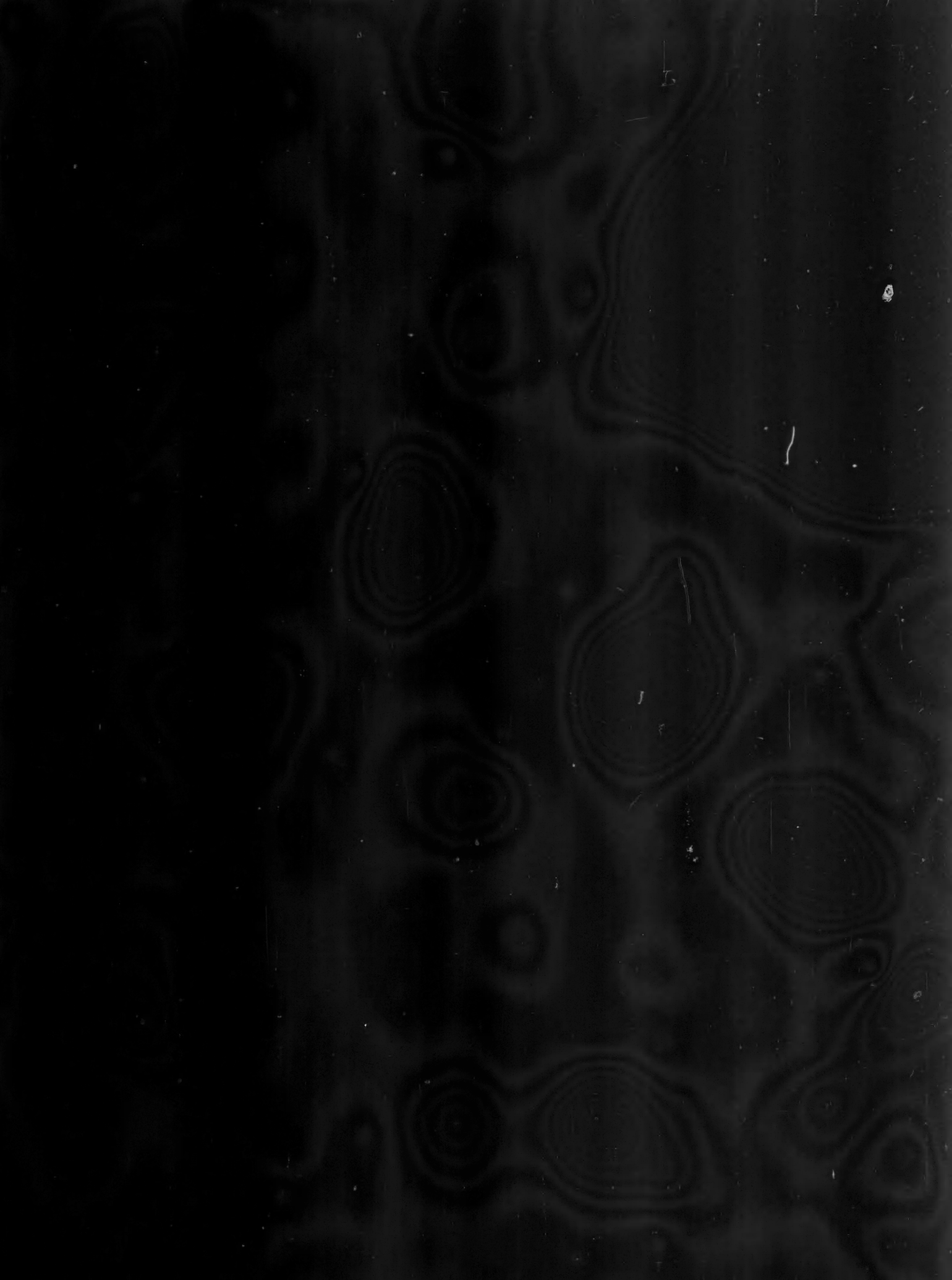
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